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VOL. IV

NUMERICAL ANALYSIS OF STIFFENED SHELLS OF REVOLUTION

Volume IV of VII

by V. Svalbonas and P. Ogilvie

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16. ABSTRACT

This manual contains engineering programming information for the STARS-2S (Shell Theory Automated for Rotational Structures -2S (statics)) digital computer program. The report is written for the engineer who will need to make small alterations to the program, such as incorporating a new geometry, or altering a table size, to fit his specific needs. The sections of the manual each cover one major subroutine. These sections are further subdivided in the following manner where applicable:

A. Subroutine description.

B. A list of pertinent engineering symbols and their FORTRAN coded counterparts.

C. Subroutine flow chart.

D. Subroutine FORTRAN listing.

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VOLUME II. Users' Manual for STARS-2S - Shell Theory Automated for Rotational Structures - 2 (Statics), Digital Computer Program

VOLUME III. Users' Manual for STARS-2B, 2V - Shell Theory Automated for Rotational Structures - 2 (Buckling, Vibrations), Digital Computer Programs

VOLUME IV. Engineer's Program Manual for STARS-2S - Shell Theory Automated for Rotational Structures - 2 (Statics), Digital Computer Program

VOLUME V. Engineer's Program Manual for STARS-2B - Shell Theory Automated for Rotational Structures -2 (Buckling), Digital Computer Program

VOLUME VI. Engineer's Program Manual for STARS-2V - Shell Theory Automated for Rotational Structures -2 (Vibration), Digital Computer Program

VOLUME VII. Satellite Programs for the STARS System

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INTRODUCTION

This manual presents a general description of the STARS-2S digital computer program. FORTRAN IV is used exclusively in writing the various subroutines. The execution of this program requires the use of eleven temporary storage units.

The program was initially written and debugged on the IBM 370-165 computer and then converted to the UNIVAC 1108 computer, where it utilizes approximately 53,000 words of core. Only basic FORTRAN Library routines are required by the program, these being: sine, cosine, absolute value, and square root.

For ease and speed in usage, the Table of Contents on the following page has also been laid out to present the call sequence of the program.

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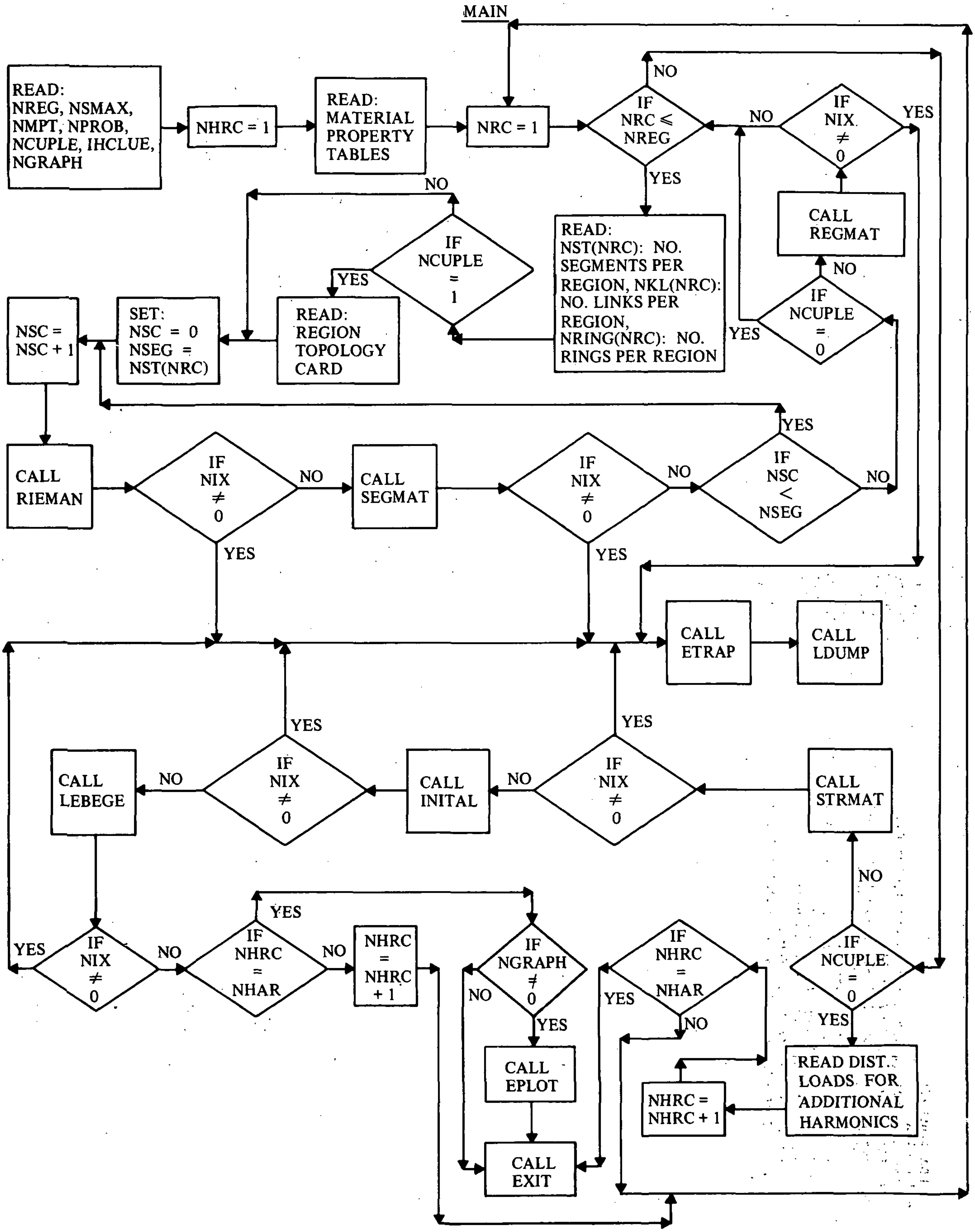
SUBROUTINE MAIN

Main is the control link for the entire program. Sizing values are read into the program and so are the material property tables. Calls are made to subroutines RIEMAN and SEGMAT once for each segment in a region; then subroutine REGMAT is called. This procedure is executed once for every region in the structure. Finally, calls are made to subroutines STRMAT, INITAL, and LEBEGE. A logic control, NIX, is used after most subroutines called by MAIN. This control determines whether the operation of the program within a subroutine was successful, and either allows further calculation, or presents an error message, as appropriate. In a multi-harmonic run the above calling sequence is in a loop on the harmonic number, and the harmonic loads are updated in this routine.

There are also several counters in this control link. These are defined as follows:

- NSC - Counts the calls to subroutines RIEMAN and SEGMAT, from 1 to the number of segments within a region.
- NRC - Counts the calls to subroutine REGMAT, from 1 to the number of regions in the structure.
- NHRC- Counts the harmonics in a multi-harmonic run.

The block data and overlay listings are included in this section.



MAIN
READ:
NREG, NSMAX,
NMPT, NPROB,
NCUPLE, IHCLUE,
NGRAPH
NHRC = 1
READ:
MATERIAL
PROPERTY
TABLES
NRC = 1
IF
NRC ≤
NREG
NO
YES
IF
NIX
≠
0
YES
NO
CALL
REGMAT
NO
IF
NCUPLE
=
0
YES
READ:
NST(NRC): NO.
SEGMENTS PER
REGION, NKL(NRC):
NO. LINKS PER
REGION,
NRING(NRC): NO.
RINGS PER REGION
IF
NCUPLE
=
1
NO
YES
READ:
REGION
TOPOLOGY
CARD
SET:
NSC = 0
NSEG =
NST(NRC)
NSC =
NSC + 1
CALL
RIEMAN
IF
NIX
≠
0
NO
YES
CALL
SEGMAT
IF
NIX
≠
0
NO
YES
IF
NSC
<
NSEG
YES
NO
CALL
ETRAP
CALL
LDUMP
CALL
LEBEGE
NO
IF
NIX
≠
0
YES
CALL
INITAL
NO
IF
NIX
≠
0
YES
CALL
STRMAT
NO
IF
NIX
≠
0
YES
NO
IF
NHRC
=
NHAR
YES
NO
NHRC
=
NHRC
+ 1
IF
NGRAPH
≠
0
NO
YES
CALL
EPLOT
CALL
EXIT
IF
NHRC
=
NHAR
YES
NO
NHRC =
NHRC + 1
IF
NCUPLE
=
0
YES
READ DIST.
LOADS FOR
ADDITIONAL
HARMONICS

```
FØR,IS BLDATA,BLDATA
      BLØCK DATA
      CØMMØN/NAM1/FACE(4),STRGØ(7),THERM(4),EQUATE(3),
     1 STRESS(5),MATER(3),SEGTAB(12)
      DATA STRGØ /11.0,13.0,21.0,31.0,12.0,14.0,15.0/
      DATA THERM /4HTHST,4HNØTH,4HTHCN,4HTHIN/
      DATA MATER /4HISØT,4HØRTH,4HSTIF/
      DATA SEGTAB/4HST10,4HTHIC,4HRWAF,4HRWA1,4HRWA2,4HRWA3,4HISG1,
     14HISG2,4HISG3,4HST11,4HST12,4HST13/
      DATA FACE /4HSING,4HEQUA,4HUNEQ,4HBLAN/
      DATA EQUATE/4HLINE,4HØMTH,4HNPHI/
      DATA STRESS/4HRING,4HSTRI,4HSHEL,4HWAFF,4HISGR/
       END
```

```
FØR,IS MAIN,MAIN
      INTEGER SAVJTC,SAVSTP,SEGTAB, Q ,THICK,TYPE
      CØMMØN STØRY(16),TALE(16),XMAT(110,10),STD(10),SADUS(30),RADUS(30)
      CØMMØN TADUS(30),UADUS(30),SAVTIC(900)
      CØMMØN XN,TEFREE,TIC,PHI,STØP,RESTØP,RTICK,G1,XNL
      CØMMØN NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)
      CØMMØN JRSTØP(30),NREG,NSEGTL,NMPT,MATPRP,NCUPLE,NRGEND,NSYM,NRG
      CØMMØN NRC,NSC,NIX,IERRØR,IØUT,MAT,KGEØM,IGEØM,ITYPE,ISTTAB,KELVIN
      CØMMØN IBEGIN,NPRØB,NHARM,NSEG,NERRØR, Q ,NSMAX,THICK
      CØMMØN/NAM1/FACE(4),STRGØ(7),THERM(4),EQUATE(3),
     1 STRESS(5),MATER(3),SEGTAB(12)
      CØMMØN /LYCØRR/ YCØRR(144)
      CØMMØN/HARMØN/ NHRC,IRCNT, HARM(25), HARPØS(25),
     1IHCLUE(2),THEANG(36),NANG,LUNSUM,LUN1,ISWICH,NUMØUT
     2,NHAR
      CØMMØN /ARING/ NRING(28)
      CØMMØN /RABBIT/ X(100),Y(100,56),LDEF(11),LANG(36),JCYC,INDEX,
     1       NØANG,NØCØRD,NGRAPH,NFLAG,LFLAG,KGM,JAM,JNSC
      INTEGER HARPØS
      DIMENSIØN IRR(30)
      DIMENSIØN LLST(6),SST(1,71)
      NFLAG = 0
    1 WRITE(6,1726)
 1726 FØRMAT(1H1)
      READ(5,1009,END=555)(STØRY(I),I=1,16)
 1009 FØRMAT(16A4)
      READ(5,1001) NREG,NSMAX,NMPT,NHAR,NPRØB,NCUPLE,IHCLUE,NGRAPH
 1001 FØRMAT(I2,I3,3I2,3I1,I2)
      READ(5,1002) (HARM(J),J=1,NHAR)
 1002 FØRMAT(14F5.0)
      IF(NHAR.GT. 1.AND.NPRØB .GT. 1 .AND. NCUPLE .EQ. 1)GØ TØ 8900
      REWIND 1
      REWIND 2
      REWIND 3
      REWIND 4
      REWIND 8
      REWIND 9
      REWIND 10
      REWIND 12
      REWIND 13
      REWIND 14
      REWIND 15
      LFLAG = 0
      NHRC= 1
      IRCNT = 0
      LUNSUM = 15
      LUN1 = 14
      ISWICH = 1
      NUMØUT = 0
      LAST1 = 0
      NIX = 0
      Q = 5
      NHARM = 1
      XN= HARM(1)
      WRITE(6,602)NSMAX,NREG,NMPT,NPRØB,NHAR,HARM(1)
  602 FØRMAT(////19X,93HUNSYMMETRIC, ØRTHØTRØPIC, REINFØRCED SHELL ANALY
     1SIS WITH CØUPLING ØF AT MØST 29 SHELL REGIØNS,//62X,-STARS 2S-,//
     262X,
     3 -AS ØF JULY 1, 1972-////8X,21HNUMBER ØF SEGMENTS = ,I3,21HNUMBER
     4ØF REGIØNS = ,I2,43H NUMBER ØF MATERIAL PRØPERTY TABLES USED = ,I2
     5,- NUMBER ØF PRØBLEMS = -,I2//8X,-NUMBER ØF HARMØNICS= -,I2,11X,
```

```
    6 -HARMØNIC  1 N= -,E14.7 )                                             200650
      IF(NHAR.EQ. 1)GØ TØ 615                                               200660
      DØ 612 I = 2,NHAR                                                     200670
      WRITE(6,609)I,HARM(I)                                                 200680
  609 FØRMAT(42X,-HARMØNIC -,I2,- N= -,E14.7 )                              200690
  612 CØNTINUE                                                              200700
  615 WRITE(6,617)                                                          200710
  617 FØRMAT(///)                                                           200720
      IF(NCUPLE.EQ.0) WRITE(6,603)                                          200730
  603 FØRMAT(28X,76HTHE GIVEN INPUT DATA INDICATES THAT THE SHELL SEGMEN    200740
     1TS ARE NØT TØ BE CØUPLED//)                                           200750
      IF(NCUPLE.EQ.1) WRITE(6,604)                                          200760
  604 FØRMAT(30X,72HTHE GIVEN INPUT DATA INDICATES THAT THE SHELL SEGMEN    200770
     1TS ARE TØ BE CØUPLED//)                                               200780
      WRITE(6,605)  (STØRY(I),I=1,16)                                       200790
  605 FØRMAT(11(/),8X,16A4,18(/),80X,35HFØR INFØRMATIØN CALL   V. SVALBØ    200800
     1NAS/117X,14H(516) 575-7701/103X,10HP. ØGILVIE)                        200810
      NRØW=0                                                                200820
      KK=-1                                                                 200830
      NSAVE=0                                                               200840
      DØ 13 I=1,NMPT                                                        200850
      KK=KK+2                                                               200860
      NXMAT(KK)=NRØW+1                                                      200870
      II=NRØW+1                                                             200880
      READ(5,1004) STD(I),TYPE                                              200890
 1004 FØRMAT (A4,6X,A4,6X)                                                  200900
      NRØW = 11                                                             200910
      DØ 11 L=1,3                                                           200920
   11 IF(TYPE.EQ.MATER(L)) GØTØ 12                                          200930
      GØ TØ 8000
   12 CØNTINUE                                                              200940
      IF(L.EQ.1) NRØW=4                                                     200950
      IF(L.EQ.2) NRØW=7                                                     200960
       LLL=NSAVE+NRØW                                                       201020
      READ (5,1005) ((XMAT(M,J),J=1,10),M=II,LLL )                          201030
 1005 FØRMAT (5E14.7)                                                       201040
      NRØW=NSAVE+NRØW                                                       201050
      NXMAT(KK+1)=LLL                                                       201060
   13 NSAVE=NRØW                                                            201070
      READ(5,2000)                                                          201080
 2000 FØRMAT(1X)                                                            201090
   14 DØ 99 NRC=1,NREG                                                      201100
      IF(Q.EQ. 1)GØ TØ 10                                                   201110
      READ(5,1003) NST(NRC),NKL(NRC),NRING(NRC),STØRY                       201120
 1003 FØRMAT(3I2,16A4)                                                      201130
   10 IF(Q .EQ. 5 .ØR. IHCLUE(2) .EQ. 0)GØ TØ 8                             201140
      GØ TØ 15                                                              201150
    8 WRITE(6,1726)                                                         201160
      WRITE(6,606)NRC,NST(NRC),NKL(NRC)                                     201170
  606 FØRMAT(/////////////////////////58X,13HREGIØN NUMBER,I3//35X,10HTH    201180
     1ERE ARE ,I2,14H SEGMENTS AND ,I2,35H KINEMATIC LINKS WITHIN THIS R    201190
     2EGIØN)                                                                201200
   15 IF(NCUPLE.EQ. 0)GØ TØ 18                                              201210
      IF (Q.EQ.1) GØ TØ 18
      READ(5,1006) IRR(NRC), JRTIC(NRC), JRSTØP(NRC),(STØRY(I),I=1,16)      201230
 1006 FØRMAT (3I5,16A4)                                                     201250
   18 NSEG= NST(NRC)                                                        201260
  201 NSC=0                                                                 201270
  101 NSC=NSC+1                                                             201280
      IF(Q.EQ.5.ØR.IHCLUE(2).EQ.0) WRITE(6,1726)
      CALL RIEMAN                                                           201300
```

```
      IF (NIX.NE.0) GØTØ 8888
      CALL SEGMAT
      IF (NIX.NE.0) GØTØ 8888
      IF(NSC.LT.NSEG) GØ TØ 101
      NSC= 0
      IF(NCUPLE .EQ. 0)GØ TØ 99
  102 CALL REGMAT
      IF(NIX.LT.0) GØ TØ 8888
      NIX = 0
       REWIND 2
       REWIND 3
   99 CØNTINUE
      IF(NCUPLE.EQ.1) GØ TØ 103
      IF (Q.EQ.5) READ(5,2000)
C
      REWIND 1
      WRITE(6,1726)
C
C
C     FØR AN UNCØUPLED MULTI-HARMØNIC RUN,READ IN DISTRIBUTED LØADS FØR
C     ADDITIØNAL HARMØNICS
C
      IF(Q.EQ.1)GØ TØ 19
      HARPØS(1) = IRCNT
      IF(NHAR.EQ. 1)GØ TØ 19
      DØ 670 II=2,NHAR
      IRCNT=0
      DØ 651 LLL=1,NSMAX
      L=0
      JJ=1
      JJJ=6
      READ(5,662)(LLST(J),J=1,6),NPP
  662 FØRMAT(6I1,64X,I2)
      IRCNT = IRCNT+1
      WRITE(13)(LLST(J),J=1,6),(TALE(I),I=1,16)
      IF(LLST(1))8031,664,610
  610 L = LLST(1)
  664 JJ = JJ+1
  631 IF(LLST(JJ))8031,625,620
  620 L = L+1
  625 IF(JJ.EQ. JJJ)GØ TØ 630
      JJ=JJ+1
      GØ TØ 631
  630 IF(L.EQ. 0)GØ TØ 651
      DØ 640 M = 1,L
      READ(5,635)(SST(1,J),J=1,NPP)
  635 FØRMAT(5E14.7)
      IRCNT = IRCNT+1
      WRITE(13)(SST(1,J),J=1,NPP)
  640 CØNTINUE
  651 CØNTINUE
      HARPØS(II) = IRCNT
  670 CØNTINUE
      READ(5,2000)
C
C
      GØ TØ 19
C
C
  103 CALL STRMAT
      IF (NIX.NE.0) GØTØ 8888
```

```
      REWIND 1
      IF (IHCLUE(1) .NE. 0)GØ TØ 135
      LAST1 = 1
      WRITE(LUNSUM)LAST1, LAST2
      WRITE(LUN1)LAST1,LAST2
      IHCLUE(1) = 2
  135 IF (IHCLUE(1) .EQ. 2) GØ TØ 105
      READ(LUNSUM) LAST1, LAST2
      NHRC = LAST1
      LAST1 = LAST1 + 1
      WRITE(LUN1)LAST1,LAST2
      IHCLUE(1) = 2
      GØ TØ 19
105   CALL INITAL
      CALL LEBEGE
      IF (ISWICH .EQ. 1)GØ TØ 140
      ISWICH = 1
      LUNSUM = 15
      LUN1 = 14
      GØ TØ 145
  140 LUNSUM = 14
      LUN1 = 15
      ISWICH = 2
  145 LAST1 = NHRC
      REWIND LUNSUM
      REWIND LUN1
      READ(LUNSUM)LAST1,LAST2
      IF(NHRC.EQ.NHAR)GØ TØ 1
      NNHRC = NHRC + 1
      WRITE(LUN1)NNHRC,LAST2
      WRITE(6,147)NHRC,LUNSUM
  147 FØRMAT(/////,1X,4H*** ,
     1            -HARMØNIC-,I4,- IS CØMPLETE. IF JØB TERMINATES ABNØRMALL
     *Y, SAVE TAPE  SAVE-,I2,-  FØR RESTART.-)
C
C
   19 Q=1
      REWIND 13
      NHRC= NHRC+1
      IF(NHRC .GT. NHAR) GØ TØ 1
      XN= HARM(NHRC)
      ISKIP= 0
      NN= NHRC-1
      DØ 22 I=1,NN
      ISKIP= HARPØS(I) + ISKIP
   22 CØNTINUE
      DØ 25 I =1,ISKIP
      READ(13) A
   25 CØNTINUE
      IRCNT= 0
C
C
      REWIND 1
      REWIND 2
      REWIND 3
      REWIND 4
      REWIND 8
      REWIND 9
      REWIND 10
      REWIND 12
      IF(IHCLUE(2) .EQ. 1)GØ TØ 14
```

```
      WRITE(6,1729)NHRC,HARM(NHRC)                                         202540
 1729 FØRMAT(1H1,/////////////////////,60X,-HARMØNIC -,I2,//60X,-N= -,     202550
     1F10.4)                                                               202560
      GØ TØ 14                                                             202570
C                                                                          202580
  555 IF (NGRAPH.NE.0) CALL ENDJØB
      STØP                                                                 202600
 8000 IERRØR=8000                                                          202610
      NERRØR= 1                                                            202620
      GØ TØ 8888                                                           202630
 8031 IERRØR = 8031                                                        202640
      NERRØR = 9                                                           202650
 8888 CALL PDUMP
      CALL ETRAP                                                           202680
      STØP                                                                 202690
 8900 WRITE(6,8901)                                                        202700
 8901 FØRMAT(///,1X,-*** THERE CAN BE ØNLY ØNE LØAD CASE ØN A MULTI HARM   202710
     *ØNIC PRØBLEM- )                                                      202720
      STØP                                                                 202730
       END                                                                 202740
```

OVERLAY

```
SEG RØØT
IN NBF24$
IN MAIN,BLDATA
SEG RIE*,(RØØT)
IN RIEMAN,SETUP,RØBØT,GEØMET,PLINE,PLICØ
SEG DF1*,(RIE)
IN DIF1
SEG DF2*,(RIE)
IN DIFF2
SEG SGMAT*,(RØØT)
IN SEGMAT,SREVN2
SEG RING*,(RØØT)
IN RINGER
SEG REG*,(RING)
IN REGMAT,SWITCH,CHASE,FUTILE,TRIEQ
SEG STR*,(RING)
IN STRMAT,FLEX
SEG INI*,(RØØT)
IN INITAL
SEG LEB*,(RØØT)
IN LEBEGE,FIXEM,TØBAR,TEMØEG,PLYNE,PLYCØ,GRAPH
SEG ØUT*,(LEB)
IN ØUTPUT,ARRAYS
SEG ØD1*,(LEB)
IN ØDE1
SEG ØD2*,(LEB)
IN ØDE2
SEG TRAP*,(RØØT)
IN ETRAP
```

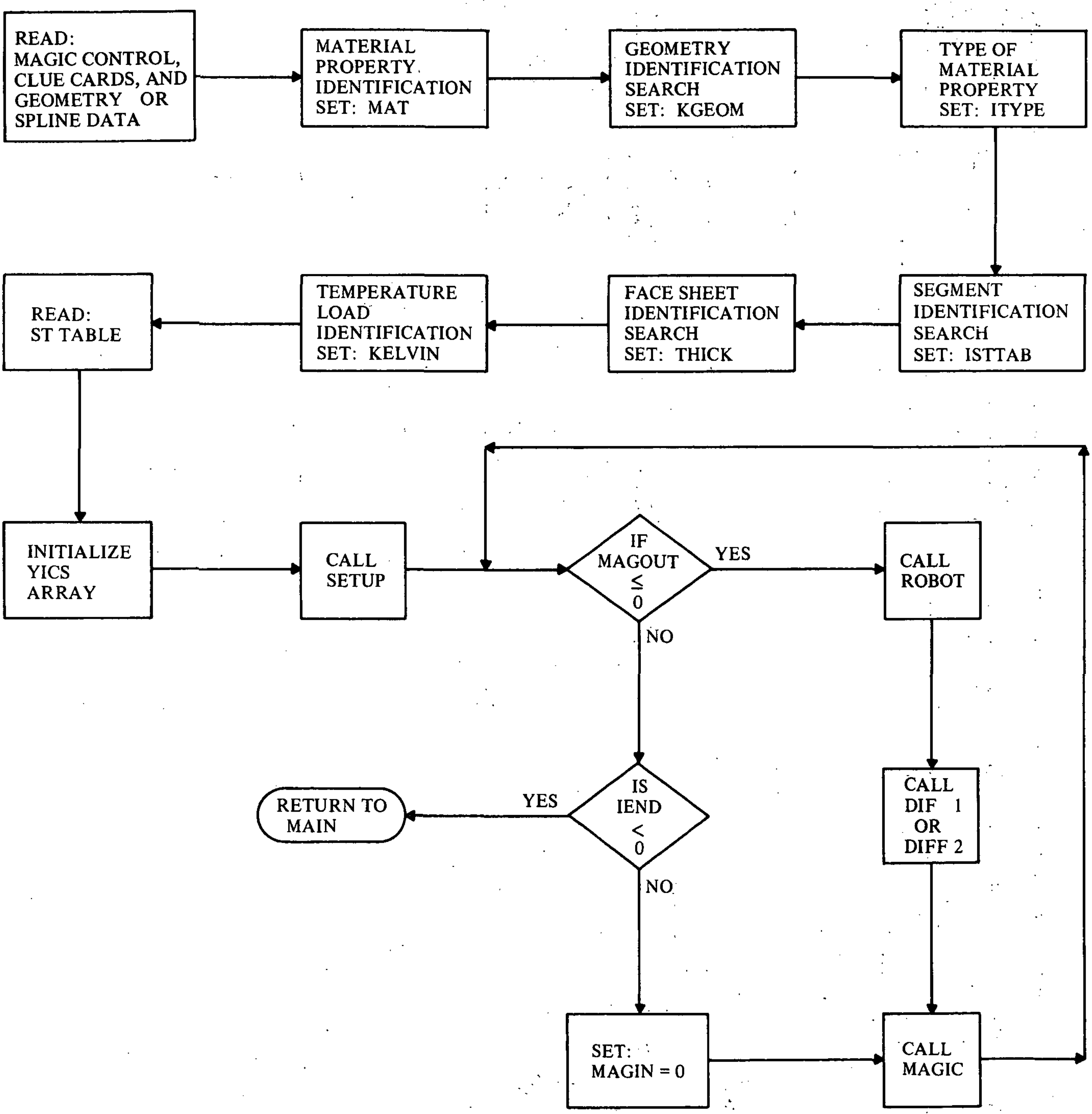
SUBROUTINE RIEMAN

This subroutine link assembles the data tables for use in the integration procedure. The program has the capability of handling at most 10 problems, each with 5 non-temperature load conditions. If however, temperature loads are included, the program will include the thermal stresses in all the load conditi A multi-harmonic run can encompass only 1 loading condition.

The subprogram link, RIEMAN, utilizes the subroutines SETUP, ROBOT, DIF1, or DIFF2, to integrate the differential equations of each segment independently, under arbitrary load conditions. The results of the integrations of each segme are stored in the YCORR array in RIEMAN, and represent the stiffness and deflec coefficients of each segment.

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
XFTHLD	f_θ
XFPHLD	f_ϕ
XFZELD	f_ζ
XMTHLD	m_θ
XMPHLD	m_ϕ
ETHET	E_θ
EPHI	E_ϕ
XGPT	$G_{\phi\theta}$
XNUTP	$\nu_{\theta\phi}$
XNUPT	$\nu_{\phi\theta}$
ALPHTH	α_θ
ALPHPH	α_ϕ
XNTTH	$N_{T\theta}$
XNTPH	$N_{T\phi}$
XMTTH	$M_{T\theta}$
XMTPH	$M_{T\phi}$
XK11	K_{11}
XK22	K_{22}
XD11	D_{11}
XD22	D_{22}
XK33	K_{33}
XD33	D_{33}

RIEMAN


READ: MAGIC CONTROL, CLUE CARDS, AND GEOMETRY OR SPLINE DATA
MATERIAL PROPERTY IDENTIFICATION SET: MAT
GEOMETRY IDENTIFICATION SEARCH SET: KGEOM
TYPE OF MATERIAL PROPERTY SET: ITYPE
SEGMENT IDENTIFICATION SEARCH SET: ISTTAB
FACE SHEET IDENTIFICATION SEARCH SET: THICK
TEMPERATURE LOAD IDENTIFICATION SET: KELVIN
READ: ST TABLE
INITIALIZE YICS ARRAY
CALL SETUP
IF MAGOUT ≤ 0
YES
NO
CALL ROBOT
CALL DIF 1 OR DIFF 2
IS IEND < 0
YES
NO
RETURN TO MAIN
SET: MAGIN = 0
CALL MAGIC

```
FØR,IS RIEMAN,RIEMAN
      SUBRØUTINE RIEMAN                                                 300030
      INTEGER SAVJTC,SAVSTP,SEGTAB, Q ,THICK,TYPE                       300040
      CØMMØN STØRY(16),TALE(16),XMAT(110,10),STD(10),SADUS(30),RADUS(30) 300050
      CØMMØN TADUS(30),UADUS(30),SAVTIC(900)                            300060
      CØMMØN XN,TEFREE,TIC,PHI,STØP,RESTØP,RTICK,G1,XNL                 300070
      CØMMØN NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)  300080
      CØMMØN JRSTØP(30),NREG,NSEGTL,NMPT,MATPRP,NCUPLE,NRGEND,NSYM,NRG  300090
      CØMMØN NRC,NSC,NIX,IERRØR,IØUT,MAT,KGEØM,IGEØM,ITYPE,ISTTAB,KELVIN 300100
      CØMMØN IBEGIN,NPRØB,NHARM,NSEG,NERRØR, Q ,NSMAX,THICK             300110
      CØMMØN/NAM1/FACE(4),STRGØ(7),THERM(4),EQUATE(3),                  300120
     1 STRESS(5),MATER(3),SEGTAB(12)                                    300130
      CØMMØN /LYCØRR/ YCØRR(144)                                        300140
      CØMMØN/HARMØN/ NHRC,IRCNT, HARM(25), HARPØS(25),                  300150
     1IHCLUE(2),THEANG(36),NANG,LUNSUM,LUN1,ISWICH,NUMØUT                300160
     2,NHAR                                                             300170
      INTEGER HARPØS                                                    300180
      EQUIVALENCE (XMTTH,XMTETH),(XMTPH,XMTEPH),(XNTTH,XNTETH),         300190
     1            (XNTPH,XNTEPH)                                        300200
      EQUIVALENCE  (XNPHI,XNPI)                                         300210
      DIMENSIØN VAR(4)                                                  300220
      DIMENSIØN KLUE(4)                                                 300230
      DIMENSIØN LST(61)
      DIMENSIØN          YDEV(144),YICS(144),YNEW(144)                  300250
      DIMENSIØN TBDEL(144),            FWDEL(144)                       300260
      DIMENSIØN ST(72,31),XLAYER(10)                                    300280
      DIMENSIØN TMPAV(5)                                                300290
      DØUBLE  PRECISIØN  YNEW,YPRED                                     300300
      CØMMØN /EQUAZN/ YPRED(144),YDØT(144),YASAVE(144),                 300310
     1               YANTH,YAMTH,YAMPT,YAJPH,                           300320
     2               S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,         300330
     3               X1RØ,X1RØSQ,X1SNRØ,X1CSRØ,CN1RØ,SN1RØ,CS1RØ,       300340
     4               X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RØ,BESQ,   300350
     5    RØSQ,XNSQ,BETA,R1,R2,S1,R1DØT,                                300360
     6               XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,      300370
     7  XMTHLD,XMPHLD,ETHET(2),EPHI(2),XGPT(2),ALPHTH(2),ALPHPH(2),     300380
     8               XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,    300390
     9               XK11,XK12,XK21,XK22,XK33,XD11,                     300400
     A   XNPHI,M,I,        BETTA,XC16,XC14,XC25                         300410
      CØMMØN /SPLINS/ ANG,PSI(100),RAD(100),CUR1(100),CUR2(100),        300420
     1        DR1DP(100),ZI(14),RI(14),NRZIN                            300430
 1726 FØRMAT(1H1)                                                       300440
      KKELV= 0                                                          300480
      KSWICH= 0                                                         300490
      IØUT = 0                                                          300500
      XNL=0.0                                                           300510
      IF(Q.EQ.1)  GØ TØ 191                                             300520
      READ(5,1001,END=9998) RGØ,ANG,STØRY                               300530
 1001 FØRMAT(F2.0,A1,16A4)                                              300540
      WRITE(1) RGØ,ANG,STØRY                                            300550
      READ(5,1002)DTAU,DIFF,STEP,DELTA                                  300560
 1002 FØRMAT(3E14.1,28X,F2.0)                                           300570
      WRITE(1)DTAU,  DIFF,STEP,DELTA                                    300580
      IF (RGØ.EQ.14.0) GØ TØ 180                                        300590
      READ (5,1002) G1,G2,G3                                            300600
      WRITE(1)       G1,G2,G3                                           300610
      GØ TØ 481                                                         300620
  180 READ(5,198) NRZIN,(ZI(J),RI(J),J=1,NRZIN)                         300630
  198 FØRMAT(I2,7F10.0/7F10.0)
      WRITE(1) NRZIN,(ZI(J),RI(J),J=1,NRZIN)                            300650
  481 CØNTINUE                                                          300660
```

```
      READ (5,1003) TYPE,HLAYR,SHEET,INTERP,RANKIN,TEFREE,ANALYS,NP
      IF(NP.LT.2.ØR.NP.GT.30) GØ TØ 8787
 1003 FØRMAT (5(A4,6X),E10.1,A4,6X,I2)
      WRITE(1)      TYPE,HLAYR,SHEET,INTERP,RANKIN,TEFREE,ANALYS,NP
      GØ TØ 192
  191 READ(1) RGØ,ANG,STØRY
      READ(1)DTAU,DIFF,STEP,DELTA
      IF (RGØ.EQ.14.0) GØ TØ 182
      READ (1      ) G1,G2,G3
      GØ TØ 183
  182 READ(1) NRZIN,(ZI(J),RI(J),J=1,NRZIN)
  183 CØNTINUE
      READ (1      ) TYPE,HLAYR,SHEET,INTERP,RANKIN,TEFREE,ANALYS,NP
  192 EPSIL =1.0E-05
      ERR = 1.0 E-07
      I = RGØ
      IF(IHCLUE(2) .EQ. 1 .AND. Q .EQ. 1)GØ TØ 642
      IF(Q.EQ.5)GØ TØ 233
      WRITE(6,231)NSC,I,(STØRY(LI),LI=1,16)
  231 FØRMAT(//13X,-SEGMENT NUMBER -,I2,5X,-SEGMENT CØDE -,I2,5X,16A4)
      GØ TØ 642
  233 CØNTINUE
      WRITE(6,651)NSC,I,(STØRY(I),I=1,16),DTAU,DIFF,STEP,
     1            DELTA
  651 FØRMAT(//13X,15HSEGMENT NUMBER ,I2,5X,13HSEGMENT CØDE ,I2,5X,
     116A4//22X,4HDTAU,15X,4HDIFF,
     215X,4HSTEP,10X,5HDELTA//12X,3(E14.7,5X),2X,F2.0)
  642 IPR = 0
      IF(Q .EQ. 1 .AND. NCUPLE .EQ. 1)GØ TØ 645
      IPR = 1
      IF (RGØ.EQ.14.0) GØ TØ 185
      WRITE(6,652)  G1,G2,G3
  652 FØRMAT(//54X,24HGEØMETRY INPUT VARIABLES,//38X,3(E14.7,5X))
  653 FØRMAT(//12X5(A4,6X),9HT FREE = ,E10.3,2XA4,6X26HNUMBER ØF TABLE C
     1ØLUMNS = ,I2)
      GØ TØ 645
  185 WRITE(6,186) (ZI(I),RI(I),I=1,NRZIN)
  186 FØRMAT(//57X,24HGEØMETRY INPUT VARIABLES//42X,16HAXIAL CØØRDINATE,
     1       9X,6HRADIUS/50X,1HZ,20X,1HR/(43X,1P1E15.8,5X,1P1E15.8))
C     MATERIAL PRØPERTY IDENTIFICATIØN
  645 IF(IPR.EQ.1)WRITE(6,653)TYPE,HLAYR,SHEET,INTERP,RANKIN,TEFREE,
     1ANALYS,NP
      DØ 501 I=1,NMPT
      IF (HLAYR-STD(I)) 501,502,501
  502 MAT=I
      GØTØ 503
  501 CØNTINUE
      GØTØ 8036
C     GEØMETRY IDENTIFICATIØN SEARCH
  503 DØ 504 I = 1,7
      IF(RGØ-STRGØ(I)) 504,505,504
  504 CØNTINUE
      GØTØ 8086
  505 KGEØM=I
      DØ 506 I=1,3
      IF(TYPE-MATER(I))506,507,506
  506 CØNTINUE
      GØTØ 8087
  507 ITYPE=I
      DØ 510 I=1,12
      IF(INTERP-SEGTAB(I))510,511,510
```

```
 510 CØNTINUE
     GØ TØ 8088
 511 ISTTAB=I
     DØ 508 I=1,4
     IF (SHEET-FACE(I)) 508,509,508
 508 CØNTINUE
     GØTØ 8089
 509 THICK=I
     KLUE2=1
     GØ TØ (430,430,420,420,420,420,425,425,425, 430,430,430),ISTTAB
 420 KLUE2=2
     GØ TØ 430
 425 KLUE2=3
 430 KLUE1=THICK
C
C     TEMPERATURE LØAD IDENTIFICATIØN
     DØ 401 I=1,4
     IF (RANKIN-THERM(I)) 401,402,401
 401 CØNTINUE
     GØTØ 8090
 402 KELVIN=I
C    LINEAR ØR NØNLINEAR ANALYSIS IDENTIFICATIØN
     DØ 403 I=1,3
     IF (ANALYS-EQUATE(I)) 403,404,403
 403 CØNTINUE
     GØTØ 8013
 404 IANLYZ=I
     IF(HARM(1).EQ.0..AND. KELVIN .NE. 2)KSWICH = 1
     IF(NHAR.EQ.1)KSWICH=0
     IF(IANLYZ .NE.1 .AND. NHAR .GT. 1)GØ TØ 8989
     IF (IANLYZ.NE.1.AND.NPRØB.GT.1) GØTØ 8009
     IF(IANLYZ.NE.1) XNL =1.0
     IF(XNL.NE.0.0.AND.XN.NE.C.0) GØ TØ 8501
     NRØW = 0
     NRØW = THICK + 1
C
     IF (ISTTAB.EQ.1) NRØW = 11
     IF(ISTTAB.EQ.3)NRØW=13
     IF(ISTTAB.EQ.4.ØR.ISTTAB.EQ.7)NRØW=7
     IF(ISTTAB.EQ.5.ØR.ISTTAB.EQ.8)NRØW=8
     IF(ISTTAB.EQ.6.ØR.ISTTAB.EQ.9)NRØW=9
     IF(ISTTAB.EQ.10)NRØW=12
     IF(ISTTAB.EQ.11)NRØW=13
     IF(ISTTAB.EQ.12)NRØW=14
C
     L= 2*(MAT-1)+1
     II=NXMAT(L)
     III=NXMAT(L+1)
     IF (IPR .EQ. 0)GØ TØ 646
     WRITE(6,654)  ((XMAT(I,J),J=1,10),I=II,III)
 654 FØRMAT(//51X,28HMATERIAL PRØPERTY TABLE USED,//(10(1H ,E12.5)))
     DØ 608 M=3,10
     IF(XMAT(II,M-1).LT. XMAT(II,M))GØ TØ 608
     IF (XMAT(II,M)) 8114,608,8114
 608 CØNTINUE
     WRITE(6,655)
 655 FØRMAT(//42X, 47HTABLE ØRDER PHI ØR S VS. CRØSSECTIØN PRØPERTIES,)
 646 DØ 901 I = 1,NRØW
     IF(Q.EQ.1)  GØ TØ 193
     READ (5,1005) (ST(I,J),J=1,NP)
1005 FØRMAT (5E14.7)
```

```
      WRITE(1)        (ST(I,J),J=1,NP)
      GØ TØ 194
  193 READ (1      ) (ST(I,J),J=1,NP)
  194 IF (IPR .EQ. 0)GØ TØ 901
      WRITE(6,600)(ST(I,J),J=1,NP)
  600 FØRMAT(1H ,8(E14.7,2X)/(3X,8(E14.7,2X)))
  901 CØNTINUE
C
      IF(G1 .EQ. 0.0 .AND. KGEØM .EQ. 3 )GØ TØ 902
      GØ TØ 903
  902 S= ST(1,1)/ST(1,NP)
      IF(0.01 .LT. S .AND. S .LT. 100.0)GØ TØ 903
      IERRØR= 8116
      NERRØR= 43
      WRITE(6,8116)IERRØR
 8116 FØRMAT(////59X,-IERRØR= -,I4,///,4X,
     1                      -WARNING- FØR AN ANNULAR PLATE NEAR THE AXIS ØF
     2REVØLUTIØN, THE END PØINT LØCATIØNS SHØULD BE IN A RATIØ BETWEEN .
     301 AND 100.-//)
  903 CØNTINUE
C
      FIC = ST(1,1)
      STØP = ST(1,NP)
      KK = NRØW
      IF(NPRØB.EQ.0) GØ TØ 590
      K=NRØW+1
      JJ=1
      JJJ=6
      MM=1
      DØ 17 NLC=1,NPRØB
      JT = JJ
      JTT= JJJ
      L=0
      IF(Q.EQ.1)  GØ TØ 195
C
C
      READ (5,1004) (LST(J),J=JJ,JJJ),(TALE(I),I=1,16)
 1004 FØRMAT(6I1,16A4)
      IRCNT = IRCNT + 1
      WRITE(13) (LST(J),J=JJ,JJJ),(TALE(I),I=1,16)
      GØ TØ 196
  195 READ(13) (LST(J),J= JJ,JJJ),(TALE(I),I=1,16)
  196 CØNTINUE
      IF(LST(JJ))8031,19,20
   20 L = LST(JJ)
      IF(NLC.GT.1.AND.LST(JT).NE.0) GØ TØ 8008
   19 JJ=JJ+1
   23 IF(LST(JJ))8031,22,21
   21 L=L+1
   22 IF(JJ.EQ.JJJ) GØTØ 24
      JJ=JJ+1
      GØTØ 23
   24 IF(L.EQ.0) GØ TØ 71
      KK = K + L - 1
      DØ 72 M=K,KK
      IF(Q.EQ.1)  GØ TØ 197
C
      IRCNT = IRCNT + 1
      READ (5,1005) (ST(M,J),J=1,NP)
      WRITE(13) (ST(M,J),J=1,NP)
      GØ TØ 72
```

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  197 READ(13) (ST(M,J),J=1,NP)
   72 CØNTINUE
      IF(NLC.GT.1.ØR.LST(1).EQ.0) GØ TØ 660
      IF(IPR.EQ.0)GØ TØ 648
      WRITE(6,656)
  656 FØRMAT(//45X,42HTABLE ØRDER PHI ØR S VS. TEMPERATURE LØADS,)
  648 KY = K
      KZ = K + LST(1) -1
      IF(IPR.EQ.0)GØ TØ 649
      DØ 657 N=KY,KZ
      WRITE(6,600) (ST(N,J),J=1,NP)
  657 CØNTINUE
  649 K = KZ+1
  660 IF((L-LST(JT)).EQ.0) GØ TØ 665
      IF(IPR.EQ.0)GØ TØ 665
      WRITE(6,661) NLC
  661 FØRMAT(//16X,8HPRØBLEM ,I2,5X,84HTABLE ØRDER  PHI ØR S VS. DISTRIB
     1UTED LØADS (F THETA, F PHI, F ZETA, M THETA, M PHI),)
      WRITE(6,1968) (LST(J),J=JT,JTT)
 1968 FØRMAT(27H LØAD IDENTIFICATIØN CLUES ,6I1/)
      DØ 662 N = K, KK
      WRITE(6,600) (ST(N,J),J=1,NP)
  662 CØNTINUE
  665 CØNTINUE
   71 K = K + L - LST(JT)
      JJ=JJJ+1
      JJJ=JJ+5
   17 MM=MM+1
      IF(IANLYZ.EQ.1) GØ TØ 590
      KK = KK + 1
      IF (L.EQ.0) KK = NRØW + 1
      IF(Q.EQ.1) GØ TØ 181
      READ(5,1005)  (ST(KK,J),J=1,NP)
      WRITE(1)      (ST(KK,J),J=1,NP)
      GØ TØ 667
  181 READ(1)       (ST(KK,J),J=1,NP)
  667 IF(IPR.EQ.0)GØ TØ 590
      WRITE(6,666)(ST(KK,J),J=1,NP)
  666 FØRMAT(//47X,38HASSUMED NØN-LINEAR VALUES VS. PHI ØR S//(1H ,
     19(E14.7,2X)))
  590 IF(NCUPLE.EQ.0) GØ TØ 7
      IF (ISTTAB.LE.3) GØ TØ 597
C
C
  593 IF(Q.EQ.1)GØ TØ 915
      READ(5,1006)(VAR(I),I=1,4)
 1006 FØRMAT(4(A4,6X))
      WRITE(1)(VAR(I),I=1,4)
      GØ TØ 920
  915 READ(1)(VAR(I),I=1,4)
      IF(IPR.EQ.0)GØ TØ 632
  920 WRITE(6,644)(VAR(I),I=1,4)
  644 FØRMAT(//34X,23HTHE STRESS CLUES ARE    ,4(A4,6X))
C     STRESS CLUES IDENTIFICATIØN
  632 I = 0
  406 I = I + 1
      DØ 405 J=1,5
      IF (VAR(I)-STRESS(J)) 405,407,405
  405 CØNTINUE
      GØ TØ 8111
  407 KLUE(I) = J
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      IF(I.LT.4) GØ TØ 406                                              303110
      IF(Q.EQ.5)GØ TØ 411                                               303120
      READ(1)(KLUE(I),I=1,4)                                            303130
      GØ TØ 413                                                         303140
  411 WRITE(1)(KLUE(I),I=1,4)                                           303150
  413 CØNTINUE                                                          303140
      K = KK+1                                                          303170
      KK=K+1                                                            303180
      IF(ISTTAB.GE.10..AND. ISTTAB.LE.12)KK  =K+3                       303190
      IF(IPR.EQ.0)GØ TØ 633                                             303200
      WRITE(6,594)                                                      303210
  594 FØRMAT(//44X,43HTABLE ØRDER  PHI ØR S VS. STRESS PRØPERTIES/)     303220
  633 DØ 596 I = K,KK                                                   303230
C                                                                       303240
      IF(Q.EQ.1)GØ TØ 930                                               303250
      READ(5,1005)  (ST(I,J),J=1,NP)                                    303260
      WRITE(1) (ST(I,J),J=1,NP)                                         303270
      GØ TØ 940                                                         303280
  930 READ(1) (ST(I,J), J=1,NP)                                         303290
      IF(IPR .EQ. 0)GØ TØ 596                                           303300
  940 WRITE (6,600)(ST(I,J),J=1,NP)                                     303310
  596 CØNTINUE                                                          303320
  597 CØNTINUE                                                          303330
      IF(Q.EQ.1)GØ TØ 945                                               303340
      READ (5,591) IS,SAVJTC(IS),SAVSTP(IS),(STØRY(I),I=1,16)           303350
      READ(5,2000)                                                      303360
 2000 FØRMAT(1X)                                                        303370
      WRITE(1) IS,SAVJTC(IS),SAVSTP(IS),(STØRY(I),I=1,16)               303380
      GØ TØ 960                                                         303390
  591 FØRMAT (3I5,16A4)                                                 303400
  945 READ(1) IS,SAVJTC(IS),SAVSTP(IS), (STØRY(I),I=1,16)               303410
  960 ITIC= SAVJTC(IS)                                                  303420
      ISTØP = SAVSTP(IS)                                                303430
      JTIC = JRTIC(NRC)                                                 303440
      JSTØP = JRSTØP(NRC)                                               303450
    7 CØNTINUE                                                          303460
      NEQNS=64+8*NPRØB                                                  303470
      DØ 73 I=1,NEQNS                                                   303480
   73 YICS(I)=0.0                                                       303490
      YICS(5) =1.0                                                      303500
      YICS(14)=1.0                                                      303510
      YICS(23)=1.0                                                      303520
      YICS(32)=1.0                                                      303530
      YICS(33)=1.0                                                      303540
      YICS(42)=1.0                                                      303550
      YICS(51)=1.0                                                      303560
      YICS(60)=1.0                                                      303570
      NCYC=0                                                            303580
      NSAVE=NRØW                                                        303590
      IEND=0                                                            303600
      PRINT=TIC                                                         303610
      DTA=DTAU                                                          303620
      DTAU=0.0                                                          303630
      KMAG=0                                                            303670
      IF(           KSWICH.EQ.1.AND.NHRC.NE.1)READ(1)(TMPAV(I),I=1,5)   303680
   59 CALL SETUP (MAGIN,MAGØUT,TIC,STEP,NEQNS,DTAU,EPSIL,DELTA,ERR,TIME, 303690
     1DTIME,YICS,YPRED,YCØRR,YDØT,YNEW,YDEV,FWDEL,TBDEL,KMAG)           303700
      GØTØ  61                                                          303710
60    CALL MAGIC(MAGIN,MAGØUT,TIC,STEP,NEQNS,DTAU,EPSIL,DELTA,ERR,TIME,
     *DTIME,YICS,YPRED,YCØRR,YDØT,YNEW,YDEV,FWDEL,TBDEL,KMAG)
   61 IF(MAGØUT.LE.0) GØTØ 25                                           303750
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      IF(NHRC .NE. 1 .ØR. KSWICH .EQ. 0)GØ TØ 69                        303760
      WRITE(1)(TMPAV(I),I=1,5)                                          303770
   69 IF(TIME.GT.STØP)GØ TØ 62                                          303780
      IF(TIME.LT.STØP) GØTØ 63                                          303790
   64 IEND=-1                                                           303800
      GØTØ 67                                                           303810
   62 IF(TIME.LE.(STØP+DIFF)) GØTØ 64                                   303820
      GØTØ 8001                                                         303830
   63 IF((STØP-DIFF).LE.TIME) GØTØ 64                                   303840
      IF((TIME+DTIME).GT.STØP) GØTØ 65                                  303850
      IF(PRINT.GT.TIME) GØTØ 66                                         303860
      PRINT=TIME+DTA                                                    303870
   67 IF(IØUT.NE.0) GØTØ 110                                            303880
      IF(IEND.GT.0) GØTØ 8002                                           303890
      IF(IEND.LT.0) GØTØ  150                                           303900
   66 MAGIN=0                                                           303910
      GØTØ 60                                                           303920
   65 DTIME=STØP-TIME                                                   303930
      DELTA=0.0                                                         303940
      GØTØ 67                                                           303950
   75 NCYC=NCYC+1                                                       303960
      MAGIN=-1                                                          303970
      GØTØ 60                                                           303990
   25 LT=0                                                              304000
      IF(NHRC.EQ. 1 .ØR. KSWICH .EQ. 0)GØ TØ 26                         304010
      IF(KMAG.EQ.4)                   READ(1)(TMPAV(I),I=1,5)           304020
   26 CØNTINUE                                                          304030
      JJ=NPRØB*6                                                        304040
      DØ 15  J=1,JJ                                                     304050
   15 LT=LT+LST(J)                                                      304060
      NTØTAL=LT+NSAVE                                                   304070
      IF(XNL.EQ.1.0) NTØTAL = NTØTAL + 1                                304080
      IF (NCUPLE.EQ.0) GØ TØ 70                                         304090
      IF(ISTTAB.GE.10.AND.ISTTAB.LE.12)NTØTAL=NTØTAL+4                  304100
      IF (ISTTAB.GT.3.AND.ISTTAB.LE.9) NTØTAL = NTØTAL+2                304110
   70 CØNTINUE                                                          304120
      PHI=TIME                                                          304130
      ARG=PHI                                                           304140
      LL=NP+1                                                           304150
      DØ 51 I=1,NP                                                      304160
      IF(ARG-ST(1,I)) 52,55,51                                          304170
   52 IF(I-1) 55,55,54                                                  304180
   51 CØNTINUE                                                          304190
      I=NP                                                              304200
      GØ TØ 55                                                          304210
   54 DØ 57 IK=2,NTØTAL                                                 304220
   57 ST(IK,LL)=ST(IK,I-1)+(ST(IK,I)-ST(IK,I-1))*(ARG-ST(1,I-1))/(ST(1,I 304230
     1)-ST(1,I-1))                                                      304240
      GØTØ 80                                                           304250
   55 DØ 58 IK=2,NTØTAL                                                 304260
   58 ST(IK,LL)=ST(IK,I)                                                304270
   80 CØNTINUE                                                          304280
C     THE UPDATED INTERPØLATED VALUES ØF THE MATERIAL PRØPERTY CØEFFIC  304290
C     IENTS ARE FØUND IN THE XMAT TABLE AND STØRED IN THE XLAYER ARRAY  304300
      L=(MAT-1)*2+1                                                     304310
      II=NXMAT(L)                                                       304320
       III=NXMAT(L+1)                                                   304330
      LL=NP+1                                                           304340
      L=NRØW + 1                                                        304350
      IF(KELVIN .NE. 1)GØ TØ 81                                         304360
      IF(THICK.NE.1)GØ TØ 83                                            304370
```

```
 81 LØØP=1
    ILØW=1
    IHIGH = 1
    IF(KELVIN .NE. 1)GØ TØ 85
 82 IF(NHRC .NE. 1 .AND.KSWICH .EQ. 1)GØ TØ 85
    TMPAV(ILØW)=(ST(L,LL)+ ST(L+1,LL)+ ST(L+2,LL) + ST(L+3,LL))/4.0
    GØ TØ 85
 83 LØØP = 2
    ILØW= 1
    IHIGH = 2
    IF(NHRC .NE. 1 .AND.KSWICH .EQ. 1)GØ TØ 85
    TMPAV(ILØW)= (ST(L,LL)+ ST(L+1,LL))/2.0
    TMPAV(IHIGH)=(ST(L+2,LL) + ST(L+3,LL))/2.0
 85 DØ 105 IL=ILØW,IHIGH
    M = 1
    GØTØ (91,92,93,93),KELVIN
 91 ARG= TMPAV(IL)
    GØTØ 94
 93 ARG =TMPAV(1)
    IF(NHRC.NE. 1.AND.KSWICH .EQ. 1)GØ TØ 94
    ARG = ST(NRØW+1,LL)
    TMPAV(1) = ARG
 94 DØ 104 I = 2,10
    IF (ARG-XMAT(II,I)) 121,123,104
121 IF (I-2) 8007,8007,124
104 CØNTINUE
    GØTØ 8067
123 L=II+1
    DØ 122 J=L,III
    XLAYER(M)=XMAT(J,I)
122 M=M+1
    GØTØ 111
124 L=II+1
    DØ 125 J=L,III
    XLAYER(M)=XMAT(J,I-1)+(XMAT(J,I)-XMAT(J,I-1))*(ARG-XMAT(II,I-1))/
   1          (XMAT(II,I)-XMAT(II,I-1))
125 M=M+1
    GØTØ 111
 92 L = II + 1
    DØ 922  J=L,III
    XLAYER(M)= XMAT(J,1)
922 M=M+1
111 GØ TØ (115,115,112,113,114),LØØP
112 XNUTP= XLAYER(2)
    IF(ITYPE.NE. 1)GØ TØ 131
    XNUPT= XNUTP
    XGPT(1) = ETHET(1)/(2*(1+ XNUPT))
    XGPT(2) = ETHET(2)/(2*(1+ XNUPT))
    GØ TØ 106
131 XNUTP = XLAYER(3)
    XNUPT = ETHET(1)*XNUTP/EPHI(1)
    GØ TØ 106
113 ES= XLAYER(8)
    ALPHS=XLAYER(10)
    GØ TØ 106
114 ALPHR = XLAYER(9)
    ER = XLAYER(7)
    GØ TØ 118
115 GØ TØ(101,102,103),ITYPE
101 ETHET(IL)= XLAYER(1)
    XNUTP    =XLAYER(2)
```

```
      ALPHTH(IL)= XLAYER(3)
      EPHI(IL) = ETHET(IL)
      XNUPT= XNUTP
      ALPHPH(IL)= ALPHTH(IL)
      XGPT(IL)= ETHET(IL)/(2.0*(1.0+ XNUPT))
      GØ TØ 105
  102 ETHET(IL)= XLAYER(1)
      EPHI(IL) = XLAYER(2)
      XNUTP = XLAYER(3)
      ALPHTH(IL)= XLAYER(4)
      ALPHPH(IL)= XLAYER(5)
      XGPT(IL) = XLAYER(6)
      XNUPT= ETHET(IL)* XNUTP/EPHI(IL)
      GØ TØ 105
  103 ETHET(IL) = XLAYER(1)
      EPHI(IL)= XLAYER(2)
      XNUTP= XLAYER(3)
      ALPHTH(IL) = XLAYER(4)
      ALPHPH(IL) = XLAYER(5)
      XGPT(IL) = XLAYER(6)
      ER= XLAYER(7)
      ES =XLAYER(8)
      ALPHR = XLAYER(9)
      ALPHS = XLAYER(10)
      XNUPT = ETHET(IL) * XNUTP/EPHI(IL)
  105 CØNTINUE
  106 L = NRØW+1
      GØ TØ (117,107,108,119,118),LØØP
  107 LØØP= 3
      ILØW = 3
      IHIGH= 3
      GØ TØ 82
  108 IF(ITYPE .EQ.3 .AND. ISTTAB .GE. 3)GØ TØ 109
      GØ TØ 118
  109 LØØP= 4
      ILØW =4
      IHIGH = 4
      IF(NHRC.NE.1 .AND.KSWICH .EQ. 1 )GØ TØ 85
      CPH = ST(3,LL)
      IF(ISTTAB.GE. 10.AND. ISTTAB.LE. 12)CPH = ST(6,LL)
      IF(CPH      .LE.0)GØ TØ 281
      TMPAV(4)= ST(L,LL)
      GØ TØ 85
  281 TMPAV(4) =ST(L+3,LL)
      GØ TØ 85
  119 LØØP=5
      ILØW=5
      IHIGH=5
      IF(NHRC .NE.1 .AND. KSWICH .EQ. 1)GØ TØ 85
      CTH = ST(3,LL)
      IF(ISTTAB.GE. 10.AND. ISTTAB.LE. 12)CTH = ST(7,LL)
      IF(CTH     .LE. 0)GØ TØ 116
      TMPAV(5)= ST(L,LL)
      GØ TØ 85
  116 TMPAV(5)= ST(L+3,LL)
      GØ TØ 85
  117 CØNTINUE
      ETHET(2)= ETHET(1)
      ALPHTH(2)=ALPHTH(1)
      ALPHPH(2)=ALPHPH(1)
      XGPT(2)= XGPT(1)
```

```
      EPHI(2)= EPHI(1)
  118 CØNTINUE
      CALL RØBØT (ST,KLUE2,NRØW,LL,ER,ES,ZINTH,ZØUTTH,G2,G3,TIME,
     1ITIC,JTIC,NTØTAL,NCYC)
      IF (NIX.NE.0) GØ TØ 9999
C     CØMPUTATIØN ØF K AND D FØR K AND D INPUT
      LL=NP+1
      IF(XK11.EQ.0.0) GØTØ 8101
      IF(ITYPE.EQ.3.AND.XK12.EQ.0.) GØ TØ 8102
      IF(ITYPE.EQ.3.AND.XK21.EQ.0.) GØ TØ 8103
      IF(XK22.EQ.0.0) GØTØ 8104
      IF(XK33.EQ.0.0) GØTØ 8105
      IF(XD11.EQ.0.0) GØTØ 8106
      IF(ITYPE.EQ.3.AND.XD12.EQ.0.) GØ TØ 8107
      IF(ITYPE.EQ.3.AND.XD21.EQ.0.) GØ TØ 8108
      IF(XD22.EQ.0.0) GØTØ 8109
      IF(XD33.EQ.0.0) GØTØ 8110
      NL=0
      XSAVE1 = XNTTH
      XSAVE2 = XNTPH
      XSAVE3 = XMTTH
      XSAVE4 = XMTPH
      XNTTH = 0.0
      XNTPH = 0.0
      XMTTH = 0.0
      XMTPH = 0.0
      XFTHLD=0.0
      XFPHLD=0.0
      XFZELD=0.0
      XMTHLD=0.0
      XMPHLD=0.0
      JF=8+NPRØB
      K = NRØW
C     ANALYS=LINE
C     ANALYS=ØMTH
C     ANALYS=NPH
      XNPHI= 0.0
      IJKLMN=NRØW+LST(1)+LST(2)+LST(3)+LST(4)+LST(5)+LST(6)+1
      IF(XNL.NE.0.0)XNPHI=ST(IJKLMN,LL)
      DØ 77 M=1, JF
      I = (M-1)*8 + 1
      IF (M.LT.9) GØTØ   49
      XNTTH = XSAVE1
      XNTPH = XSAVE2
      XMTTH = XSAVE3
      XMTPH = XSAVE4
      NL=NL+1
      XFTHLD=0.0
      XFPHLD=0.0
      XFZELD=0.0
      XMTHLD=0.0
      XMPHLD=0.0
      IR=NL*6-5
      IF(LST(IR).NE.0) K=K+LST(IR)
      IF (LST(IR+1).EQ.0) GØTØ 44
      K=K+1
      XFTHLD=ST(K,LL)
   44 IF(LST(IR+2).EQ.0) GØTØ 45
      K=K+1
      XFPHLD=ST(K,LL)
   45 IF(LST(IR+3).EQ.0) GØTØ 46
```

```
      K=K+1
      XFZELD=ST(K,LL)
   46 IF(LST(IR+4).EQ.0) GØTØ 47
      K=K+1
      XMTHLD=ST(K,LL)
   47 IF(LST(IR+5).EQ.0) GØTØ 48
      K=K+1
      XMPHLD=ST(K,LL)
   48 CØNTINUE
   49 IF(ISTTAB.GE.3.AND.ISTTAB.LE.9)GØ TØ 4002
      CALL DIF1
      GØ TØ 77
 4002 CALL DIFF2
   77 CØNTINUE
      GØTØ 75
 8001 IERRØR=8001
      NERRØR=11
      GØTØ 8888
 8002 IERRØR=8002
      NERRØR=12
      GØTØ 8888
 8007 IERRØR=8007
      NERRØR=15
      GØTØ 8888
 8008 IERRØR = 8008
      NERRØR=10
      GØ TØ 8888
 8009 IERRØR = 8009
      NERRØR= 8
      GØ TØ 8888
 8031 IERRØR=8031
      NERRØR= 9
      GØTØ 8888
 8036 IERRØR=8036
      NERRØR= 2
      GØTØ 8888
 8086 IERRØR=8086
      NERRØR= 3
      GØTØ 8888
 8087 IERRØR=8087
      NERRØR= 4
      GØTØ 8888
 8088 IERRØR=8088
      NERRØR=27
      GØTØ 8888
 8089 IERRØR=8089
      NERRØR= 5
      GØTØ 8888
 8090 IERRØR=8090
      NERRØR= 6
      GØTØ 8888
 8067 IERRØR= 8067
      NERRØR=16
      GØTØ 8888
 8101 IERRØR = 8101
      NERRØR=17
      GØTØ 8888
 8102 IERRØR = 8102
      NERRØR=18
      GØTØ 8888
 8103 IERRØR = 8103
```

```
      NERRØR=19
      GØTØ 8888
 8104 IERRØR = 8104
      NERRØR=20
      GØTØ 8888
 8105 IERRØR = 8105
      NERRØR=21
      GØTØ 8888
 8106 IERRØR = 8106
      NERRØR=22
      GØTØ 8888
 8107 IERRØR = 8107
      NERRØR=23
      GØTØ 8888
 8108 IERRØR = 8108
      NERRØR=24
      GØTØ 8888
 8109 IERRØR = 8109
      NERRØR=25
      GØTØ 8888
 8110 IERRØR = 8110
      NERRØR=26
      GØTØ 8888
  110 IERRØR=110
      NERRØR=28
      GØTØ 8888
 8013 IERRØR=8013
      NERRØR= 7
      GØTØ 8888
 8787 IERRØR = 8787
      NERRØR=34
      GØ TØ 8888
 8501 IERRØR=8501
      NERRØR=35
      GØ TØ 8888
 8111 IERRØR = 8111
      NERRØR = 36
      GØ TØ 8888
8114  IERRØR= 8114
      NERRØR= 41
      GØ TØ 8888
 8888 NIX=1
      RETURN
  150 CØNTINUE
      IF (IPR.EQ.0) GØ TØ 9875
      WRITE(6,670)
  670 FØRMAT(//46X,41HMATRIX X AND Y (TRANSPØSED)  MAGIC ØUTPUT)
      WRITE(6,672)  (YCØRR(I),I=1,NEQNS)
  672 FØRMAT(8(2X,E14.7))
 9875 RESTØP = RØ
      IF(NCUPLE.EQ.0) GØ TØ 9999
      RADUS(ISTØP) = RØ
      IADUS(ISTØP)=RØ
      IF(NSC.LT.NSEG) GØ TØ 9999
      SADUS(JSTØP) = RØ
      UADUS(JSTØP)=RØ
      IF(ITIC.LE.ISTØP) GØ TØ 9999
      SADUS(JSTØP)=RADUS(ITIC)
      UADUS(JSTØP)=RADUS(ITIC)
 9999 RETURN
 8989 WRITE(6,8991)
```

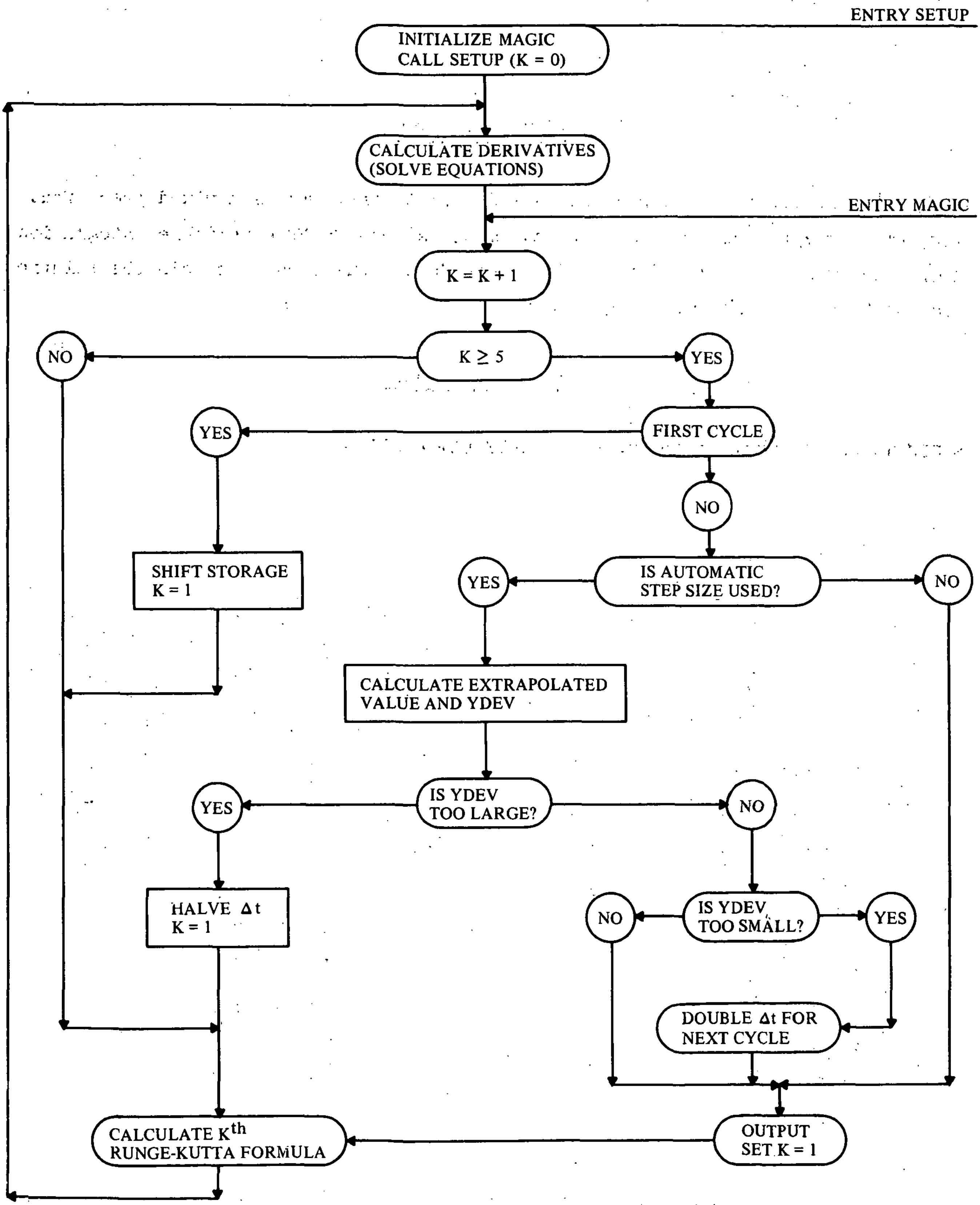
```
8991 FØRMAT(//,1X,-MULTI-HARMØNIC PRØBLEM MUST BE LINEAR- STØP**- )
     STØP
9998 WRITE(6,9997)
9997 FØRMAT(-THE PRØGRAM HAS PRØCESSED ALL THE DATA FØR A CHAIN ØF UNCØ
    1UPLED SEGMENTS-)
     CALL EXIT
     STØP
      END
```

SUBROUTINE SETUP

SETUP is a double entry subroutine called from RIEMAN. It is a mixed precision, numerical integration routine, with automatic selection of a variable integration step size, which utilizes fifth order Runge-Kutta equations to obtain the solutio for first order differential equations.

SUBROUTINE MAGIC

MAGIC is an alternate entry point to subroutine SETUP.


ENTRY SETUP
INITIALIZE MAGIC
CALL SETUP (K = 0)
CALCULATE DERIVATIVES
(SOLVE EQUATIONS)
ENTRY MAGIC
K = K + 1
NO
K ≥ 5
YES
YES
FIRST CYCLE
NO
SHIFT STORAGE
K = 1
YES
IS AUTOMATIC
STEP SIZE USED?
NO
CALCULATE EXTRAPOLATED
VALUE AND YDEV
YES
IS YDEV
TOO LARGE?
NO
HALVE Δt
K = 1
NO
IS YDEV
TOO SMALL?
YES
DOUBLE Δt FOR
NEXT CYCLE
CALCULATE K th
RUNGE-KUTTA FORMULA
OUTPUT
SET K = 1

```
FØR,IS SETUP,SETUP
      SUBRØUTINE SETUP (MAGIN,MAGØUT,TIC,STEP,NEQNS,DTAU,
     1                  EPSIL,DELTA,ERR,TIME,DTIME,YICS,YPRED,
     2 YCØRR,YDØT,YNEW,YDEV,FWDEL,TBDEL,K)
      DIMENSIØN YICS(1),YPRED(1),YCØRR(1),YDØT(1),YNEW(1),
     1          YDEV(1),FWDEL(1),TBDEL(1)
      DIMENSIØN C(3),D(3)
      DØUBLE PRECISIØN YNEW,YPRED
      DATA C,D / .5,.5,1.0,.5,.0,.5/
      TIME = TIC
      TAU  = TIC
      IF (DELTA)200,201,200
  200 DTIME = 0.0078125
      GØ TØ 225
  201 DTIME = STEP
  225 DØ 102 I = 1,NEQNS
      YDEV(I)  = 0.0
      YPRED(I) = YICS(I)
      YCØRR(I) = YICS(I)
  102 YNEW(I)  = YICS(I)
      MAGØUT   =-2
      GØ TØ 264
 5555 CØNTINUE
      ENTRY MAGIC (MAGIN,MAGØUT,TIC,STEP,NEQNS,DTAU,EPSIL,DELTA,ERR,
     1 TIME,DTIME,YICS,YPRED,YCØRR,YDØT,YNEW,YDEV,FWDEL,TBDEL,KMAG)
 5556 CØNTINUE
      IF (MAGØUT) 305,101,101
  101 IF(MAGIN) 21, 27, 14
   27 K = 0
      DØ 202 I = 1,NEQNS
  202 YNEW(I)  = YPRED(I)
   21 K = K +1
      DØ 2 I=1,NEQNS
      GØ TØ (9,6,7,4,11),K
    9 FWDEL(I) = YDØT(I)
      GØ TØ 105
    6 TBDEL(I) = YDØT(I)
      GØ TØ 105
    7 TBDEL(I) = TBDEL(I) + YDØT(I)
  105 YPRED(I) = YNEW(I) + C(K)*DTIME*YDØT(I)
      GØ TØ (2,2,400),K
  400 YCØRR(I) = YPRED(I)
    2 CØNTINUE
      TIME     = TIME + D(K)*DTIME
   99 MAGØUT   = 0.0
  264 RETURN
    4 DØ  8  I = 1,NEQNS
      YPRED(I) = YNEW(I) + DTIME*(FWDEL(I) + 2.*TBDEL(I) + YDØT(I))/6.
    8 YDEV(I)  = YCØRR(I) - YPRED(I)
      GØ TØ 99
   11 IF (DELTA)80, 5,80
   80 DØ  13 I = 1,NEQNS
      IF (EPSIL* ABS(YCØRR(I)) + ERR    -  ABS(YDEV(I)))14, 13, 13
   13 CØNTINUE
      IF (SIGB)15,15,205
  205 SIGB = 0.0
      GØ TØ 5
   15 SIGB = 0.0
      DØ 207 I = 1,NEQNS
      IF (ERR   /100.+ DELTA* ABS(YCØRR(I)) -  ABS(YDEV(I))) 5,207,207
  207 CØNTINUE
```

```
      DTIME    = 2.*DTIME
    5 DØ 208 I = 1,NEQNS
  208 YCØRR(I) = YPRED(I)
  305 IF (DTAU) 19,30,19
   19 IF (TAU - TIME)20,20,27
   20 TAU = TAU + DTAU
   30 MAGØUT = 2
      GØ TØ 264
   14 DTIME = DTIME/2.0
      IF (K-3) 48,26,26
   26 TIME  = TIME - DTIME - DTIME
      GØ TØ 47
   48 TIME  = TIME - DTIME
   47 SIGB     = +2.
      DØ 209 I = 1,NEQNS
  209 YDØT(I) = FWDEL(I)
  212 K        = 0
      GØ TØ 21
       END
```

SUBROUTINE ROBOT

This subroutine is used by RIEMAN to calculate geometric and load coefficients for use in the differential equations. With reference to geometry, all the necessary radii are calculated, as well as the stiffness coefficients of the various shell wall constructions. Thermal load moments and direct forces are also calculated from direct temperature input.

All the above values are passed back via the label common area EQUAZN.

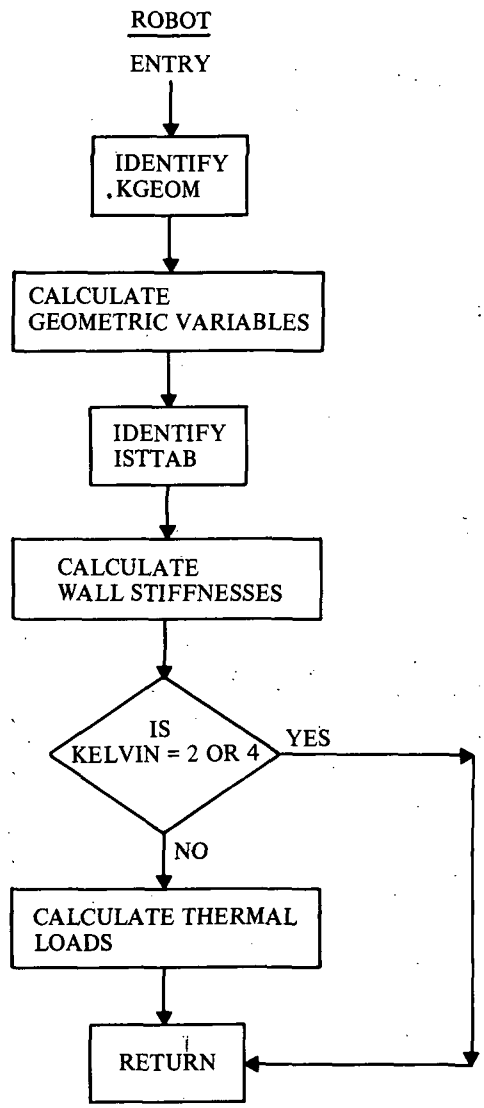
In the case of a special point input geometry the ROBOT routine calls GEOMET.

Subroutines GEOMET, PLICO, PLINE

Starting from a set of z,r points these subroutines calculate the necessary radii of the shell curves using spline fits.

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
RO	r_0
R1	r_1
R1DOT	$r_{1,\phi}$
CS	$\cos \phi$
SN	$\sin \phi$
A	a
C	c
XN	n
F2	f_2
F3	f_3
TAN; TN	$\tan \phi$
SEC	$\sec \phi$
TII	T_{ii}
TIK	T_{ic}
TOK	T_{oc}
TOO	T_{oo}
TEFREE	$\overline{T}$
HI	h_i
HO	h_o
T	t
TI	t_i
TO	t_o
SNSQ	$\sin^2\phi$
CSSQ	$\cos^2\phi$
CN	$\cos \phi \sin \phi$
X1CS	$1/\cos \phi$
X1SN	$1/\sin \phi$
R2	r_2
BETA	β

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
X1ROSN	$1/r_0 \sin \phi$
X1ROCS	$1/r_0 \cos \phi$
CSX1RO	$\cos \phi/r_0$
CSX1R1	$\cos \phi/r_1$
CSX1R2	$\cos \phi/r_2$
SNX1RO	$\sin \phi/r_0$
SNX1R1	$\sin \phi/r_1$
X1R1	$1/r_1$
X1R2	$1/r_2$
X1R1SQ	$1/r_1{}^2$
X1ROSQ	$1/r_0{}^2$


ROBOT
ENTRY
IDENTIFY KGEOM
CALCULATE GEOMETRIC VARIABLES
IDENTIFY ISTTAB
CALCULATE WALL STIFFNESSES
IS KELVIN = 2 OR 4
YES
NO
CALCULATE THERMAL LOADS
RETURN

```
FØR,IS RØBØT,RØBØT
      SUBRØUTINE RØBØT (ST,KLUE2,NRØW,LL,ER,ES,ZINTH,ZØUTTH,G2,G3,
     1TIME,ITIC,JTIC,NTØTAL,NCYC)
      INTEGER SAVJTC,SAVSTP,Q,THICK
      REAL*4 I2
      CØMMØN STØRY(16),TALE(16),XMAT(110,10),STD(10),SADUS(30),RADUS(30)
      CØMMØN TADUS(30),UADUS(30),SAVTIC(900)
      CØMMØN XN,TEFREE,TIC,PHI,STØP,RESTØP,RTICK,G1,XNL
      CØMMØN NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)
      CØMMØN JRSTØP(30),NREG,NSEGTL,NMPT,MATPRP,NCUPLE,NRGEND,NSYM,NRG
      CØMMØN NRC,NSC,NIX,IERRØR,IØUT,MAT,KGEØM,IGEØM,ITYPE,ISTTAB,KELVIN
      CØMMØN IBEGIN,NPRØB,NHARM,NSEG,NERRØR,Q,NSMAX,THICK
      DØUBLE PRECISIØN YPRED
      CØMMØN /EQUAZN/ YPRED(144),YDØT(144),YASAVE(144),YANTH,YAMTH,
     1         YAMPT,YAJPH,S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,
     2         X1RØ,X1RØSQ,X1SNRØ,X1CSRØ,CN1RØ,SN1RØ,CS1RØ,X1R1,X1R2,
     3         CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RØ,BESQ,RØSQ,XNSQ,BETA,R1,
     4         R2,S1,R1DØT,XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,
     XXMTHLD,XMPHLD,ETHET(2),EPHI(2),XGPT(2),ALPHTH(2),ALPHPH(2),
     Y   XNUTP,XNUPT,
     6         XC11,XC22,XC15,XD33,XD22,XD21,XD12,XK11,XK12,XK21,XK22,
     7         XK33,XD11,XNPHI,M,I, BETTA,XC16,   XC14,XC25
      CØMMØN /SPLINS/ ANG,PSI(100),RAD(100),CUR1(100),CUR2(100),
     1       DR1DP(100),ZI(14),RI(14),NRZIN
      DATA A/-A   -/
      DIMENSIØN ST(72,31)
C
      GØTØ (771,772,773,774,775,776,7077),KGEØM
C     GEØMETRY FØR ELIPSE(G3=ØFFSET DISTANCE )
  771 A=G1
      BE=G2
      BETA = BE
      BESQ=BE**2
      ASQ=A**2
      SN=SIN(PHI)
      CS=CØS(PHI)
      SNSQ = SN**2
      CSSQ = CS**2
      R2 = A*SQRT(1.0/(SNSQ+BESQ*CSSQ))
      R2SQ = R2**2
      RØ=R2*SN
      R1=R2*R2SQ*BESQ/ASQ
      BESQ=BE**2
      R1DØT=0.0
      IF(KGEØM.EQ.1.AND.BETA.NE.1.0.AND.SN.NE.0.0)R1DØT=3.0*(R2*BETA/
     1A) **2*(CS/SNSQ)*(R1*SN-RØ)
      IF (SN) 679,779,679
  679 R2 = R2-G3/SN
      R2SQ = R2**2
      RØ = RØ-G3
      GØ TØ 7775
  779 IF (G3) 678,7775,678
  678 R1DØT = 3.0*G3
      RØ = -G3
      GØ TØ 7775
C     GEØMETRY FØR ØGIVE
  772 R1=G1
      C=G2
      SN=SIN(PHI)
      CS=CØS(PHI)
      IF (SN) 680,777,680
```

```
  680 R2 = R1-C/SN
      GØTØ 778                                                        2500620
  777 R2 = 1.0                                                        2500630
  778 RØ = R1*SN-C                                                    2500640
      R1DØT=0.0                                                       2500650
      GØTØ 7775                                                       2500660
C     GEØMETRY FØR CØNE                                               2500670
  773 CS = CØS(G1)                                                    2500680
      SN=SIN(G1)                                                      2500690
      S=PHI                                                           2500700
      S1=1.0/S                                                        2500710
      R2=CS*SN*PHI                                                    2500720
      RØ=PHI*CS                                                       2500730
      R1DØT=0.0                                                       2500740
      GØTØ 7775                                                       2500750
C     GEØMETRY FØR CYLINDER                                           2500760
  774 RØ = G1                                                         2500770
      R1DØT=0.0                                                       2500780
      SN = 1.0                                                        2500790
      CS = 1.0                                                        2500800
      GØTØ 7775                                                       2500810
C   MØDIFIED ELLIPSE                                                  2500820
  775 XNEXP = G1                                                      2500830
      A = G2                                                          2500840
      XN1 = 1.0 + XNEXP                                               2500850
      XN2 = 1.0/XN1                                                   2500860
      XN3 = XN1 + 1.0                                                 2500870
      XN4 = XN3 + 1.0                                                 2500880
      XN5 = XN4/XN1                                                   2500890
      SN = SIN(PHI)                                                   2500900
      CS = CØS(PHI)                                                   2500910
      R2  = A*(2.0/(1.0+SN**XN1))**XN2                                2500920
      R1  = (A/2.0)*(R2/A)**XN3                                       2500930
      RØ=R2*SN                                                        2500940
      R1DØT = -XN3*A*(SN**XNEXP*CS/4.0)*(2.0/(1.0+SN**XN1))**XN5      2500950
      GØTØ 7775                                                       2500960
C     GENERAL GEØMETRY                                                2500970
  776 SN=SIN(PHI)                                                     2500980
      CS=CØS(PHI)                                                     2500990
      TAN= SN/CS                                                      2501000
      SEC= 1.0/CS                                                     2501010
      IF (TIME.EQ.TIC) CALL GEØMET                                    2501020
      ARG = PHI                                                       2501030
      DØ 204 J=1,100                                                  2501040
      PHØ = PSI(J)                                                    2501050
      IF (ANG.EQ.A) IF (ARG-PHØ) 221,223,204                          2501060
      IF (PHØ-ARG) 221,223,204                                        2501070
  221 IF (J-1) 8502,8502,224                                          2501080
  204 CØNTINUE                                                        2501090
      GØ TØ 8503                                                      2501100
  223 RØ = RAD(J)                                                     2501110
      R1 = CUR1(J)                                                    2501120
      R2 = CUR2(J)                                                    2501130
      R1DØT = DR1DP(J)                                                2501140
      GØ TØ 7775                                                      2501150
 8502 NERRØR = 43                                                     2501160
      GØ TØ 8888                                                      2501170
 8503 NERRØR = 44                                                     2501180
 8888 NIX = 1                                                         2501190
      GØ TØ 8889                                                      2501200
  224 SUB1 = ARG-PSI(J-1)                                             2501210
```

```
      SUB2 = PSI(J)-PSI(J-1)
      RØ = RAD(J-1)+(RAD(J)-RAD(J-1))*SUB1/SUB2
      R1 = CUR1(J-1)+(CUR1(J)-CUR1(J-1))*SUB1/SUB2
      R2 = CUR2(J-1)+(CUR2(J)-CUR2(J-1))*SUB1/SUB2
      R1DØT = DR1DP(J-1)+(DR1DP(J)-DR1DP(J-1))*SUB1/SUB2
      GØTØ 7775
C     ISØTENSØID GEØMETRY
 7077 CØNTINUE
      SN = SIN(PHI)
      CS = CØS(PHI)
      A  = G1
      R2 = A / SQRT(SN)
      R1 = 0.5 * R2
      RØ = R2 * SN
      R1DØT = - ((A**2)*0.5)*(R1*CS)/RØ**2
 7775 TAN=SN/CS
      IF(TIME.EQ.TIC) RTICK=RØ
      IF(NCYC.GT.1.ØR.NCUPLE.EQ.0) GØ TØ 491
      IF (TIME.EQ.TIC.AND.NSC.EQ.1) SADUS(JTIC) = RØ
      IF (TIME.EQ.TIC) RADUS(ITIC) = RØ
  491 CØNTINUE
      RØSQ = RØ**2
      XNSQ=XN**2
      CN=CS*SN
      X1CS=1.0/CS
      TN=SN/CS
      X1RØ=1.0/RØ
      X1RØSQ=1.0/RØ**2
      X1CSRØ=1.0/(CS*RØ)
      CN1RØ=CN/RØ
      SN1RØ=SN/RØ
      CS1RØ=CS/RØ
      SNSQ=SN**2
      CSSQ=CS**2
      IF(KGEØM.EQ.4.ØR.KGEØM.EQ.3) GØTØ 79
      R1SQ = R1**2
      R2SQ = R2**2
      X1SN=1.0/SN
      X1SNRØ=1.0/(SN*RØ)
      X1R1=1.0/R1
      X1R2=1.0/R2
      CS1R1=CS/R1
      CS1R2=CS/R2
      SN1R1=SN/R1
      X1R1SQ=1.0/R1**2
   79 XNTTH=0.0
      XNTPH=0.0
      XMTTH=0.0
      XMTPH = 0.
      IF(ISTTAB.LT.3.ØR.ISTTAB.GT.6)GØ TØ 273
      KL=NTØTAL-1
      ZINTH=ST(KL,LL)
      ZØUTTH=ST(KL+1,LL)
  273 CØNTINUE
C     CØMPUTATIØN ØF K AND D FØR MATERIAL PRØPETY INPUT
C
C
      GØ TØ (711,600,711,32,33,34,32,33,34,28,29,30 ),ISTTAB
C     THICK
  600 GØ TØ (703,702,701,701),THICK
  701 HØ= ST(4,LL)
```

```
  702 T = ST(3,LL)                                                          2501830
  703 HI= ST(2,LL)                                                          2501840
      GØ TØ 40                                                              2501850
C     ST11,ST12,ST13                                                        2501860
   30 HØ= ST(14,LL)                                                         2501870
   29 T = ST(13,LL)                                                         2501880
   28 HI= ST(12,LL)                                                         2501890
      GJPH= ST(2,LL)                                                        2501900
      GJTH= ST(3,LL)                                                        2501910
      APH = ST(4,LL)                                                        2501920
      ATH = ST(5,LL)                                                        2501930
      CPH = ST(6,LL)                                                        2501940
      CTH = ST(7,LL)                                                        2501950
      XIPH = ST(8,LL)                                                       2501960
      XITH= ST(9,LL)                                                        2501970
      SPH = ST(10,LL)                                                       2501980
      STH = ST(11,LL)                                                       2501990
      GØ TØ 40                                                              2502000
C     RWAF1,RWAF2,RWAF3, AND ISG1,ISG2,ISG3                                 2502010
   34 HØ=ST(9,LL)                                                           2502020
   33 T =ST(8,LL)                                                           2502030
   32 HI=ST(7,LL)                                                           2502040
      APH = ST(2,LL)                                                        2502050
      CPH = ST(3,LL)                                                        2502060
      XIPH= ST(4,LL)                                                        2502070
      SPH = ST(5,LL)                                                        2502080
      BETTA=ST(6,LL)                                                        2502090
      ATH = APH                                                             2502100
      CTH = CPH                                                             2502110
      XITH= XIPH                                                            2502120
      STH = SPH                                                             2502130
      GØ TØ 40                                                              2502150
C     ST10,RWAF                                                             2502160
C     RANKIN=THSTND MEANS INTERPØLATE,CØMPUTE NTEMP,MTEMP                   2502170
C     RANKIN=NØTHRM MEANS DØ NØT INTERPØLATE,DØ NØT CØMPUTE NTEMP,NTEMP     2502180
C     RANKIN=THCNST MEANS DØ NØT AVERAGE, BUT INTERPØLATE,CØMPUTE           2502190
C                                                      NTEMP, MTEMP         2502200
C     RANKIN=THINHØ MEANS INTERPØLATE,BUT DØ NØT CØMPUTE NTEMP,MTEMP        2502210
C                                                                           2502220
  711 CØNTINUE                                                              2502230
      XK11=ST(2,LL)                                                         2502240
      XK12=ST(3,LL)                                                         2502250
      XK22 = ST(4,LL)                                                       2502260
      XK33 = ST(5,LL)                                                       2502270
      XD11 = ST(6,LL)                                                       2502280
      XD12 = ST(7,LL)                                                       2502290
      XD22 = ST(8,LL)                                                       2502300
      XD33 = ST(9,LL)                                                       2502310
      XC11 = ST(10,LL)                                                      2502320
      XC22 = ST(11,LL)                                                      2502330
      XC15 = ST(12,LL)                                                      2502340
      XC16 = ST(13,LL)                                                      2502350
      XK21 = XK12                                                           2502360
      XD21 = XD12                                                           2502370
      GØ TØ 103                                                             2502380
C                                                                           2502390
   40 CØNTINUE                                                              2502400
      TEMP3= (1.0-XNUPT * XNUTP)                                            2502410
      PERM= TEMP3                                                           2502420
      E1= (ETHET(1)+ EPHI(1))/2.                                            2502430
      E2= (ETHET(2)+ EPHI(2))/2.                                            2502440
```

```
      ES1= E1+E2
      GØ TØ (42,47,49,41),THICK
   41 GØ TØ (103,42,103,42,47,49,42,47,49,42,47,49),ISTTAB
C
C     SINGLE SHEET
C
   42 TEMP1= ETHET(1) * HI
      TEMP2= TEMP1 * HI**2
      XK11= TEMP1/TEMP3
      XD11= TEMP2/(12.0* TEMP3)
      TEMP1= EPHI(1)* HI
      TEMP2= TEMP1*HI**2
      XK22= TEMP1/TEMP3
      XD22= TEMP2/(12.0* TEMP3)
      XK33= XGPT(1)* HI
      XD33= XK33*HI**2/12.0
      GØ TØ 55
C
C     EQUAL SHEETS
C
   47 EPSUM= EPHI(1)+ EPHI(2)
      ETSUM= ETHET(1)+ ETHET(2)
      XK11= ETSUM * HI/PERM
      XK22= EPSUM * HI/PERM
      XK33= HI*(XGPT(1)+ XGPT(2))
      ZBRIN = (HI*(E1+3.0*E2)+2.0*E2*T)/(2.0*ES1)
      ZBRØUT = (HI*(E2+3.0*E1)+2.0*E1*T)/(2.0*ES1)
      ZBHIN= (ZBRIN-HI/2.0)**2
      ZBHØUT=(ZBRØUT-HI/2.0)**2
      XD33= (HI**3*(XGPT(1)+XGPT(2)))/12.0+ HI*(XGPT(1)* ZBHIN
     1     +  XGPT(2)* ZBHØUT)
      XD11=(XK11* HI**2)/12.+ HI*( ETHET(1) * ZBHIN + ETHET(2)*ZBHØUT)
     1/PERM
      XD22=(XK22* HI**2)/12.+ HI*( EPHI(1) * ZBHIN + EPHI(2)* ZBHØUT)
     1/PERM
      GØ TØ 55
C
C     UNEQUAL FACE SHEETS
C
   49 CØNTINUE
      ZBRIN =((E1*HI**2)+(E2*HØ**2) +(2.0*E2*HØ*HI) +(2.0*E2*HØ*T)) /
     1 (2.0*(E1*HI+E2*HØ))
      ZBRØUT=((E1*HI**2)+(E2*HØ**2) +(2.0*E1*HØ*HI) +(2.0*E1*HI*T)) /
     1 (2.0*(E1*HI+E2*HØ))
      ZBHIN =(ZBRIN-HI/2.0)**2
      ZBHØUT =(ZBRØUT-HØ/2.0)**2
      XK11= (ETHET(1)* HI + ETHET(2)* HØ)/PERM
      XK22= (EPHI(1) * HI + EPHI(2) * HØ)/PERM
      XK33= XGPT(1)*HI + XGPT(2) * HØ
      XD33 = (XGPT(1)*HI**3+XGPT(2)*HØ**3)/12.+HI*(XGPT(1)*ZBHIN)+
     1 XGPT(2)*ZBHØUT*HØ
      D11 =  (ETHET(1)*HI**3 + ETHET(2)*HØ**3)/12.
      XD11=(D11+ (HI*ETHET(1)*ZBHIN)   + (HØ*ETHET(2)*ZBHØUT))/PERM
      D22 =  (EPHI(1)* HI**3 + EPHI(2)*HØ**3)/12.
      XD22= ( D22 +(HI*EPHI(1)*ZBHIN) + (HØ*EPHI(2)* ZBHØUT)) /PERM
C
C     DETERMINE CØMPLETE CØNSTANTS DEPENDENT ØN REINFØRCEMENT CLUE
C
   55 CØNTINUE
      IF(ISTTAB .EQ.2)GØ TØ 103
      EASTH=ER*ATH/STH
```

```
      EASPH=ES*APH/SPH                                                  2503060
      EISPH= ES* XIPH/SPH                                               2503070
      EISTH= ER* XITH/STH                                               2503080
      GØ TØ (58,60,100),KLUE2                                           2503090
C                                                                       2503100
C     ST CLUE(10,11,12)                                                 2503110
C                                                                       2503120
   58 CØNTINUE                                                          2503130
      XK12= XK11*XNUTP                                                  2503140
      XK11= XK11+ EASTH                                                 2503150
      XK22= XK22+ EASPH                                                 2503160
      XC11= EASTH*CTH                                                   2503170
      XC22= EASPH*CPH                                                   2503180
      XD22= - XD22 - EISPH                                              2503190
      XD33= XD33 + GJPH/(4.0*SPH)+ GJTH/(4.0*STH)                       2503200
      XD12= -XD11*XNUTP                                                 2503210
      XD11= -XD11- EISTH                                                2503220
      XK21 = XK12                                                       2503230
      XD21 = XD12                                                       2503240
      GØ TØ 103                                                         2503250
C     RAF CLUE(1,2,3)                                                   2503260
C                                                                       2503270
   60 CØNTINUE                                                          2503280
      SINB =SIN(BETTA)                                                  2503290
      CØSB =CØS(BETTA)                                                  2503300
      SN2TØ4 = 2*(SINB**4.)                                             2503310
      D= STH*(CØSB+SINB)                                                2503320
      ED = ER*ATH/D                                                     2503330
      SINB2= SINB**2.                                                   2503340
      ZBAR= ZINTH                                                       2503350
      IF(CTH.GT. 0.)GØ TØ 64                                            2503360
      ZBAR= ZØUTTH                                                      2503370
   64 CØNTINUE                                                          2503380
      IF(ZBAR.GT.0)GØ TØ 65                                             2503400
      ZBAR=-ZBAR                                                        2503410
   65 IF(CTH.GT.0.)GØ TØ 91                                             2503420
      CTHABS=-CTH                                                       2503430
      GØ TØ 92                                                          2503440
   91 CTHABS=CTH                                                        2503450
   92 HL= 2*( ZBAR -CTHABS)                                             2503460
      I2=(ATH**3.)/(3* HL**2)                                           2503470
      XC22 = 2.0*CTH*CØSB**3*ED
      XC15 = 2.0*CTH*CØSB*SINB2*ED                                      2503550
      XC16 = XC15                                                       2503560
      GRI=  ER* I2/(2.0*(1.0 + XNUTP)*D)                                2503570
      XC11 = CTH*SN2TØ4/CØSB*ED                                         2503580
      EDI = ER*XITH/D                                                   2503600
      SN4TØ2 = 4.*SINB2                                                 2503610
      XD22 = -XD22-2.0*CØSB**3*EDI-SN4TØ2*CØSB*GRI                      2503620
      TB= 2.0* BETTA                                                    2503640
      XD33 = XD33+((4.0*CØS(TB)*                                        2503660
     1*2*GRI)/ CØSB) + (2.0*CØSB*SINB2*EDI)                             2503670
      XD12 = -XD11*XNUTP-(2.0*CØSB                                      2503680
     1*SINB2*EDI)-(SN4TØ2*CØSB*GRI )                                    2503690
      XK12= XK11*XNUTP + (2.0*CØSB*SINB2*ED)                            2503700
      XK22=XK22+(2*CØSB**3*ED)                                          2503710
      XK33=XK33+(2*CØSB*SINB2*ED)                                       2503720
      XK11=XK11+(SN2TØ4*ED/CØSB)                                        2503730
      XD11 = -XD11-SN2TØ4*EDI/CØSB-(                                    2503740
     1 SN4TØ2*CØSB*GRI)                                                 2503750
      XK21 = XK12                                                       2503760
```

```
      XD21 = XD12
      GØ TØ 103
C
C     ISG CLUE(7,8,9)
C
  100 CØNTINUE
      SNB =SIN(BETTA)
      CSB =CØS(BETTA)
      TBETTA= 2.0*BETTA
      CS2B= CØS(TBETTA)
      ØNEC2B=(1.0+ CS2B)/2.
      SCB2  =(SNB-CS2B*SNB + 2.)/(2.0*CSB)
      SN2B  =SIN(TBETTA) /2.
      XK12=XK11*XNUTP + (EASTH*SNB*ØNEC2B/CSB)
      XK11=XK11+ EASTH*SCB2
      XK22=XK22+ EASTH*(CSB/SNB*ØNEC2B)
      XK33=XK33+ EASTH* SN2B
      XC11=     (EASTH*CTH* SCB2 )
      XC15=EASTH*CTH*( SNB* ØNEC2B/CSB )
      XC16=EASTH*CTH*SN2B
      XC22= EASTH*CTH* (CSB/SNB * ØNEC2B)
      XD12=-XD11*XNUTP- EISTH*(SNB*ØNEC2B/CSB)
      XD11=-XD11- EISTH*SCB2
      XD22 = -XD22-EISTH*(CSB/SNB*ØNEC2B)
      XD33= XD33+ EISTH*SN2B
      XK21 = XK12
      XD21 = XD12
C
C
C
  103 CØNTINUE
C
      GØ TØ (716,714,715,714),KELVIN
  716 TII = ST(NRØW+1,LL)
      TIK = ST(NRØW+2,LL)
      TØK = ST(NRØW+3,LL)
      TØØ = ST(NRØW+4,LL)
      GØTØ 717
  715 TII = ST(NRØW+1,LL)
      TIK = TII
      TØK = TII
      TØØ = TII
C
  717 TEMP11= ALPHTH(1)+ XNUTP * ALPHPH(1)
      TEMP12= ALPHTH(2)+ XNUTP * ALPHPH(2)
      TEMP21= ALPHPH(1)+ XNUPT * ALPHTH(1)
      TEMP22= ALPHPH(2)+ XNUPT * ALPHTH(2)
      TEMP3 = 1-XNUPT*XNUTP
      TEMP4 = HI/4.0
      ETHK1=  ETHET(1)*TEMP11/TEMP3
      TEMP5 = HI**2/24.0
      ETHK2 = ETHET(2)*TEMP12/TEMP3
      TEMP61= TII+ TIK-2* TEFREE
      TEMP62= TØØ+ TØK-2* TEFREE
      TEMP71= 2.0* TII +TIK-3*TEFREE
      TEMP72= 2.0* TØØ +TØK-3*TEFREE
      EPHK1 = EPHI(1)*TEMP21/TEMP3
      EPHK2 = EPHI(2)*TEMP22/TEMP3
      GØ TØ (811,812,813,814),THICK
C
C
```

```
811 XNTTH= ETHK1   *           TEMP4 * (TEMP61+ TEMP62)
    XNTPH= EPHK1   *           TEMP4 * (TEMP61 + TEMP62)
    XMTTH= ETHK1   *           TEMP5 * (TEMP71- TEMP72)
    XMTPH= EPHK1   *           TEMP5 * (TEMP71 - TEMP72)
    GØ TØ 714
812 TI = (HI*(E2-E1)+2.0*E2*T)/(2.0*(E1+E2))
    TØ = (HI*(E1-E2)+2.0*E1*T)/(2.0*(E1+E2))
    TEMP8= HI/2.0
    XNTTH = ETHK1   *         TEMP8*TEMP61 + ETHK2   *        TEMP8*
   1TEMP62
    XNTPH = EPHK1   *         TEMP8*TEMP61 + EPHK2   *        TEMP8*
   1TEMP62
    XMTTH =(ETHK1 *   TEMP8 * (HI*TEMP71/3.0+ TI*TEMP61)) - (ETHK2 *
   1 TEMP8*(HI*TEMP72/3.0+TØ*TEMP62))
    XMTPH =(EPHK1 *   TEMP8 * (HI*TEMP71/3.0+ TI*TEMP61)) - (EPHK2 *
   1 TEMP8*(HI*TEMP72/3.0+TØ*TEMP62))
    GØ TØ 714
813 TI = (E2*HØ**2-E1*HI**2+2.0*E2*HØ*T)/(2.0*(E1*HI+E2*HØ))
    TØ = (E1*HI**2-E2*HØ**2+2.0*E1*HI*T)/(2.0*(E1*HI+E2*HØ))
    XNTTH = ETHK1*0.5*(HI*TEMP61)+ETHK2*0.5*(HØ*TEMP62)
    XNTPH= EPHK1*0.5*(HI*TEMP61)+ EPHK2*0.5*(HØ*TEMP62)
    XMTTH = ETHK1*0.5*(HI**2*TEMP71/3.0+TI*HI*TEMP61)-ETHK2*0.5*(HØ
   1**2*TEMP72/3.+TØ*HØ*TEMP62)
    XMTPH = EPHK1*0.5*(HI**2*TEMP71/3.0+TI*HI*TEMP61)-EPHK2*0.5*(HØ
   1**2*TEMP72/3.+ TØ*HØ*TEMP62)
    GØ TØ 714
814 TEMP10=((-XK11*XD11)**.5)/(48.0**.5)
    TEM11 =((-XK22*XD22)**.5)/(48.0**.5)
    XNTTH =(XK11/4.0 *TEMP11)* TEMP61 + (XK11/4.0*TEMP12) * TEMP62
    XNTPH =(XK22/4.0 *TEMP21)* TEMP61 + (XK22/4.0*TEMP22) * TEMP62
    XMTTH =  TEMP10*(TEMP11*TEMP71 - TEMP12* TEMP72)
    XMTPH =  TEM11 *(TEMP21*TEMP71 - TEMP22* TEMP72)
714 CØNTINUE
8889 RETURN
    END
```

```
FØR,IS GEØMET,GEØMET
      SUBRØUTINE GEØMET
C     THIS SUBRØUTINE CALCULATES THE GEØMETRY FØR A SHELL SEGMENT.
C     THE INPUT VARIABLES ARE . . .
C              RI(I) - - DISTANCE FRØM AXIS ØF REV. TØ PØINTS
C                        ØN SHELL MERIDIAN.
C              ZI(I) - - DISTANCE ALØNG AXIS ØF REV. TØ THE
C                        INTERSECTIØN ØF THE CØRRESPØNDING RI(I) AND
C                        THE AXIS ØF REV.
C              NRZIN - - NUMBER ØF (RI,ZI) PAIRS READ AS INPUT.
C
      CØMMØN /SPLINS/ ANG,PSI(100),RAD(100),CUR1(100),CUR2(100),
     1       DR1DP(100),ZI(14),RI(14),NRZIN
      DIMENSIØN CI(4,13),DRDZ(14),SØUT(14),S(101),RADD(100)
C
      FUN(ARG) = SQRT(1.0 + ARG**2)
C
      RADS = 3.1415926/180.0
      DATA B/-B    -/
      AMULT = 1.0
      IF (ANG.EQ.B) AMULT = -1.0
C
C     PASS SPLINE CURVE THRØUGH INPUT PØINTS ØN SHELL MERIDIAN, AND
C     CØMPUTE DR/DZ AT THESE PØINTS.
C
      CALL PLICØ (ZI,RI,NRZIN,CI)
      NDELZ = NRZIN - 1
      DØ 60 I=1,NRZIN
      CALL PLINE (ZI,RI,NRZIN,CI,ZI(I),FAKE1,DRDZ(I),FAKE2)
   60 CØNTINUE
C
C     CØMPUTE MERIDIØNAL ARC LENGTH TØ INTERPØLATED PØINTS BY
C     NUMERICAL INTEGRATIØN (SIMPSØNS RULE).  SINCE SIMPSØNS RULE
C     REQUIRES AN EVEN NUMBER ØF PARTITIØNS, INTERPØLATE A PØINT
C     MIDWAY BETWEEN EACH PAIR ØF PØINTS USING SUBRØUTINE SPLINE.
C
      SØUT(1) = 0.
      DØ 70 I=1,NDELZ
      DZ2=(ZI(I+1)-ZI(I))/2.0
      DZ6=DZ2/3.0
      CALL PLINE (ZI,RI,NRZIN,CI,ZI(I)+DZ2,FAKE1,DRDZM,FAKE2)
      SØUT(I+1) = SØUT(I) + DZ6*(FUN(DRDZ(I)) + 4.0*FUN(DRDZM) +
     1            FUN(DRDZ(I+1)))
   70 CØNTINUE
C
C     USE SPLICØ TØ REPRESENT RI(I) AS A FUNCTIØN ØF SØUT(I).  THEN USE
C     SPLINE TØ INTERPØLATE RADD AND CØRRESPØNDING DERIVATIVES.  FRØM
C     THESE, CØMPUTE THE TWØ PRINCIPAL RADII ØF CURVATURE,
C       CUR1 = 1/R1
C       CUR2 = 1/R2
C
      ØLDH1 = SØUT(NRZIN)/99.0
      CALL PLICØ (SØUT,RI,NRZIN,CI)
      DØ 110 I=1,100
      S(I) = FLØAT(I-1)*ØLDH1
      CALL PLINE (SØUT,RI,NRZIN,CI,S(I),RAD(I),RADD(I),RADD2)
      IF (ABS(RADD(I)).GT.1.0) RADD(I)=1.0
      FACTØR = SQRT(1.0-RADD(I)**2)
      CUR1(I) = -RADD2/FACTØR
      CUR2(I) = FACTØR/RAD(I)
  110 CØNTINUE
```

```
      DØ 180 J=1,100
      CØSPSI = AMULT*RADD(J)
      PSI(J) = ARCØS(CØSPSI)
      SINPSI = -AMULT*RAD(J)*CUR2(J)
      IF (ANG.EQ.B) GØ TØ 179
      PSI(J) = 2.0*3.1415926-PSI(J)
  179 CØNTINUE
      CUR1(J) = -AMULT/CUR1(J)
      CUR2(J) = -AMULT/CUR2(J)
      IF (J.EQ.1) GØ TØ 180
      I = 1
      IF (J.EQ.2) GØ TØ 181
      I = 2
  181 IF (ANG.EQ.B) GØ TØ 190
      DR1DP(J-I) = (CUR1(J)-CUR1(J-I))/(PSI(J)-PSI(J-I))
      GØ TØ 180
  190 DR1DP(J-I) = (CUR1(J-I)-CUR1(J))/(PSI(J-I)-PSI(J))
  180 CØNTINUE
      DR1DP(100) = DR1DP(99)
      DØ 42 J=1,100
      DR1DP(J) = DR1DP(J)*0.1
   42 CØNTINUE
      RETURN
      END
```

```
FØR,IS PLICØ,PLICØ
      SUBRØUTINE PLICØ (X,Y,M,C)
C     SUBRØUTINE TØ DETERMINE C(1,K),C(2,K),C(3,K) AND C(4,K).
      DIMENSIØN X(14),Y(14),A(14,3),B(14),Z(14)
      DIMENSIØN D(13),P(13),E(13),C(4,13)
      MM = M-1
      DØ 10 K=1,MM
      D(K) = X(K+1) - X(K)
      P(K) = D(K)/6.0
   10 E(K) = (Y(K+1)-Y(K))/D(K)
      DØ 20 K=2,MM
   20 B(K) = E(K) - E(K-1)
      A(1,2) = -1.0-D(1)/D(2)
      A(1,3) = D(1)/D(2)
      A(2,3) = P(2)-P(1)*A(1,3)
      A(2,2) = 2.0*(P(1)+P(2)) - P(1)*A(1,2)
      A(2,3) = A(2,3)/A(2,2)
      B(2) = B(2)/A(2,2)
      DØ 30 K=3,MM
      A(K,2) = 2.0*(P(K-1)+P(K))-P(K-1)*A(K-1,3)
      B(K) = B(K)-P(K-1)*B(K-1)
      A(K,3) = P(K)/A(K,2)
   30 B(K) = B(K)/A(K,2)
      Q = D(M-2)/D(M-1)
      A(M,1) = 1.0+Q+A(M-2,3)
      A(M,2) = -Q-A(M,1)*A(M-1,3)
      B(M) = B(M-2)-A(M,1)*B(M-1)
      Z(M) = B(M)/A(M,2)
      MN = M-2
      DØ 40 I=1,MN
      K = M-I
   40 Z(K) = B(K)-A(K,3)*Z(K+1)
      Z(1) = -A(1,2)*Z(2)-A(1,3)*Z(3)
      DØ 50 K=1,MM
      Q = 1.0/(6.0*D(K))
      C(1,K) = Z(K)*Q
      C(2,K) = Z(K+1)*Q
      C(3,K) = Y(K)/D(K)-Z(K)*P(K)
   50 C(4,K) = Y(K+1)/D(K)-Z(K+1)*P(K)
      RETURN
      END
```

```
FØR,IS PLINE,PLINE
      SUBRØUTINE PLINE (X,Y,M,C,XINT,YINT,DYDX,D2YDX2)
C     SUBRØUTINE FØR SPLINE FIT INTERPØLATIØN IN THE TABLE ØF VALUES
C     (X1,Y1) TØ (XM,YM), WHERE M MAY BE AS LARGE AS 100, WHERE THE
C     CØNSTANTS C(1,K),C(2,K),C(3,K) AND C(4,K) ARE ALREADY CØMPUTED
C     AND STØRED.
C     SUBRØUTINE ALSØ CØMPUTES DY/DX AND D2Y/DX2 AT XINT.
      DIMENSIØN X(14),Y(14),C(4,13)
      IF (XINT-X(1)) 80,10,20
   10 YINT = Y(1)
      K=1
      GØ TØ 70
   20 K = 1
   30 IF (XINT-X(K+1)) 60,40,50
   40 YINT = Y(K+1)
      GØ TØ 70
   50 K = K + 1
      IF (M-K) 80,80,30
   60 YINT = (X(K+1) - XINT)*(C(1,K)*(X(K+1)-XINT)**2+C(3,K))
      YINT = YINT + (XINT-X(K))*(C(2,K)*(XINT-X(K))**2+C(4,K))
   70 DYDX=-3.0*(C(1,K)*(X(K+1)-XINT)**2-C(2,K)*(XINT-X(K))**2)
     1      -C(3,K)+C(4,K)
      D2YDX2=6.0*(C(1,K)*(X(K+1)-XINT)+C(2,K)*(XINT-X(K)))
      RETURN
   80 WRITE (6,90)
   90 FØRMAT (31H ØUT ØF RANGE FØR INTERPØLATIØN)
      RETURN
      END
```

SUBROUTINES DIF1 AND DIFF2

These subroutines are called in RIEMAN as necessary. DIF1 contains the differential equations for the THIC and ST clues, while DIFF2 contains the differential equations for the RWA and ISG clues. Geometry clues, trigonometric values, and predicted values of the differential equation variables are passed via label common area, EQUAZN, to subroutines DIF1 or DIFF2.

The specific derivative equations and auxiliary equations are contained in these subroutines. The values of each derivative equation, YDOT, and each auxiliary equation, YA ---, are returned to RIEMAN via label common EQUAZN.

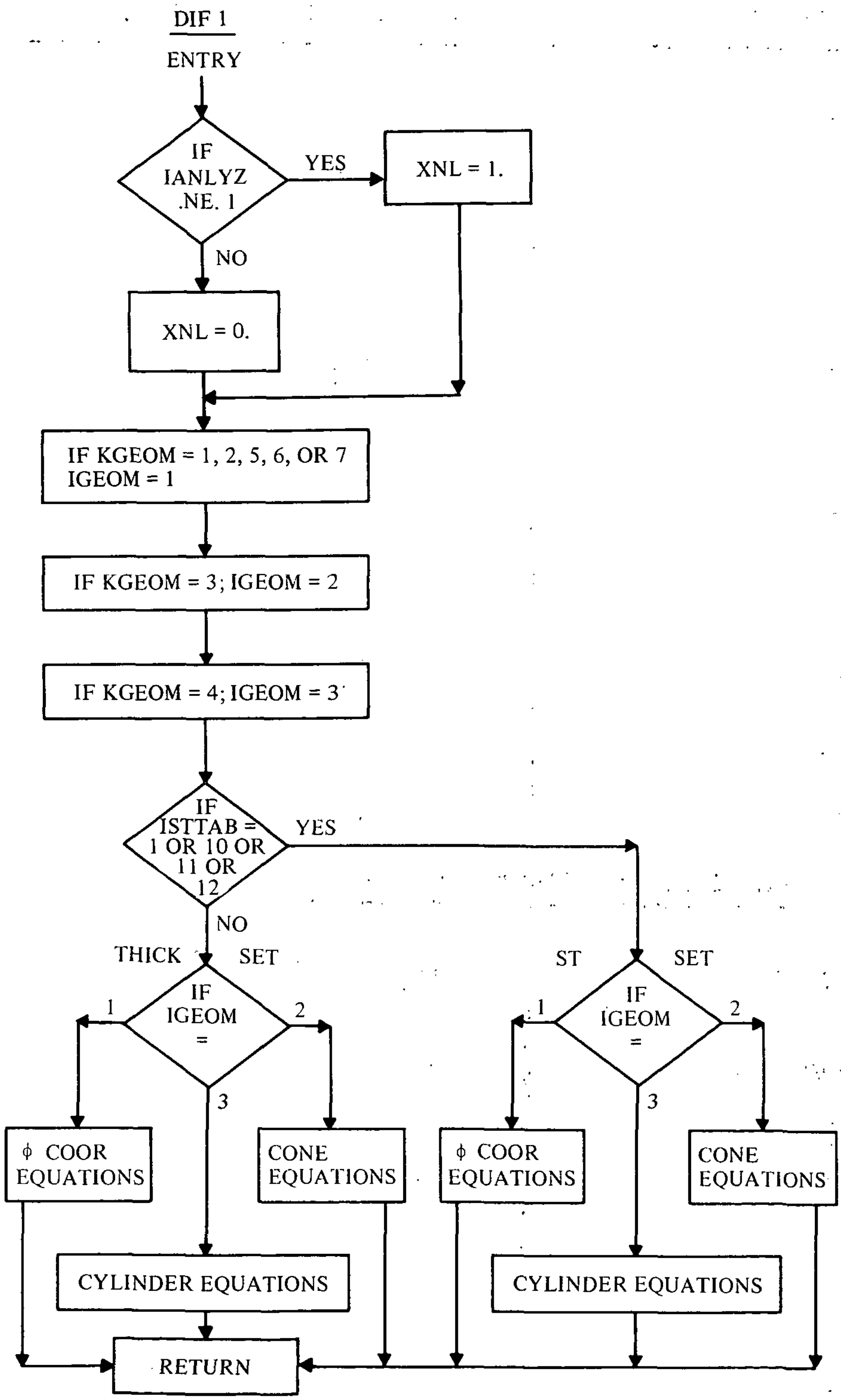
A special equation counter, I, is used in these subroutines, which counts in increments of eight. The first eight values of I, 1 through 57 (in increments of eight), correspond to the eight sets of initial conditions required to compute the segment stiffness matrices in subroutine SEGMAT. The subsequent values of I, 65 through 137 maximum (again in increments of eight) correspond to the computati of each set of eight equations for each loading condition (10 load conditions maximum).

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)	
XN	n	
YDOT (I)	$T_{\phi\theta,\phi}$	$\frac{dT_{\phi\theta}}{ds}$
YDOT (I + 1)	$N_{\phi,\phi}$	$\frac{dN_{\phi}}{ds}$
YDOT (I + 2)	$J_{\phi,\phi}$	$\frac{dJ_{\phi}}{ds}$
YDOT (I + 3)	$M_{\phi,\phi}$	$\frac{dM_{\phi}}{ds}$
YDOT (I + 4)	$U,_{\phi}$	$\frac{dU}{ds}$
YDOT (I + 5)	$V,_{\phi}$	$\frac{dV}{ds}$
YDOT (I + 6)	$W,_{\phi}$	$\frac{dW}{ds}$
YDOT (I + 7)	$\Omega_{\theta,\phi}$	$\frac{d\Omega_{\theta}}{ds}$
YPRED (I)	$T_{\phi\theta}$	
YPRED (I + 1)	N_{ϕ}	
YPRED (I + 2)	J_{ϕ}	
YPRED (I + 3)	M_{ϕ}	
YPRED (I + 4)	U	
YPRED (I + 5)	V	
YPRED (I + 6)	W	
YPRED (I + 7)	Ω_{θ}	
YAMPT	$M_{\phi\theta}$	
YANTH	N_{θ}	
YAMTH	M_{θ}	

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
R2SQ	r_2^2
ROSQ	r_0^2
X1RO	$1/r_0$
S	s
XK12	K_{12}
XK21	K_{21}
XD12	D_{12}
XD21	D_{21}
XC11	C_{11}
XC22	C_{22}
XNSQ	n^2

Non-Linear Redefinitions (Ref. 1)

YDOT (I+2)	$*J_{\phi,\phi}$	$\frac{d*J_\phi}{ds}$
YPRED (I+2)	$*J_\phi$	
YAJPH	J_ϕ	
XNPHI	$\overline{N}$	

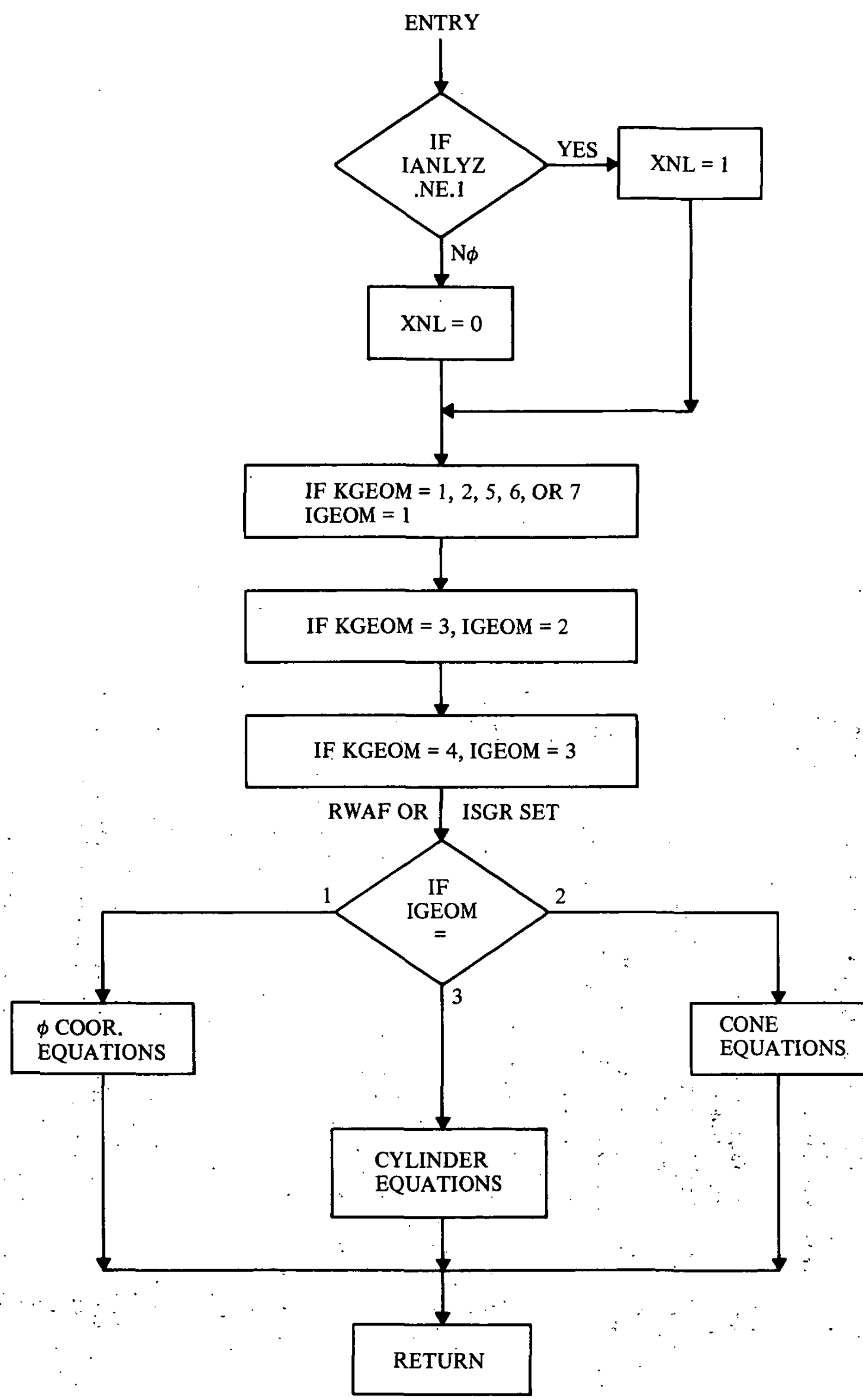

DIF 1
ENTRY
IF IANLYZ .NE. 1
YES
XNL = 1.
NO
XNL = 0.
IF KGEOM = 1, 2, 5, 6, OR 7
IGEOM = 1
IF KGEOM = 3; IGEOM = 2
IF KGEOM = 4; IGEOM = 3
IF ISTTAB = 1 OR 10 OR 11 OR 12
YES
NO
THICK
SET
ST
SET
IF IGEOM =
1
2
3
ϕ COOR EQUATIONS
CONE EQUATIONS
CYLINDER EQUATIONS
IF IGEOM =
1
2
3
ϕ COOR EQUATIONS
CONE EQUATIONS
CYLINDER EQUATIONS
RETURN

```
FØR,IS DIF1,DIF1
      SUBRØUTINE DIF1                                                   500030
      INTEGER SAVJTC,SAVSTP,Q,THICK
      CØMMØN STØRY(16),TALE(16),XMAT(110,10),STD(10),SADUS(30),RADUS(30)  500050
      CØMMØN TADUS(30),UADUS(30),SAVTIC(900)                            500060
      CØMMØN XN,TEFREE,TIC,PHI,STØP,RESTØP,RTICK,G1,XNL                 500070
      CØMMØN NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)  500080
      CØMMØN JRSTØP(30),NREG,NSEGTL,NMPT,MATPRP,NCUPLE,NRGEND,NSYM,NRG  500090
      CØMMØN NRC,NSC,NIX,IERRØR,IØUT,MAT,KGEØM,IGEØM,ITYPE,ISTTAB,KELVIN  500100
      CØMMØN IBEGIN,NPRØB,NHARM,NSEG,NERRØR, Q ,NSMAX,THICK             500110
      EQUIVALENCE (XMTTH,XMTETH),(XMTPH,XMTEPH),(XNTTH,XNTETH),         500120
     1            (XNTPH,XNTEPH)                                        500130
      EQUIVALENCE  (XNPHI,XNPI)                                         500140
      DØUBLE PRECISIØN YPRED                                            500150
      CØMMØN /EQUAZN/ YPRED(144),YDØT(144),YASAVE(144),                 500160
     1                YANTH,YAMTH,YAMPT,YAJPH,                          500170
     2                S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,        500180
     3                X1RØ,X1RØSQ,X1SNRØ,X1CSRØ,CN1RØ,SN1RØ,CS1RØ,      500190
     4                X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RØ,BESQ,  500200
     5   RØSQ,XNSQ,BETA,R1,R2,S1,R1DØT,                                 500210
     6                XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,     500220
     7  XMTHLD,XMPHLD,ETHET(2),EPHI(2),XGPT(2),ALPHTH(2),ALPHPH(2),     500230
     8                XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,   500240
     9                XK11,XK12,XK21,XK22,XK33,XD11,                    500250
     A   XNPHI,M,I,         BETTA,XC16,XC14,XC25                        500260
      IGEØM = 0                                                         500270
      IF (KGEØM.EQ.1.ØR.KGEØM.EQ.2.ØR.KGEØM.EQ.5.ØR.KGEØM.EQ.6) IGEØM =1  500280
      IF (KGEØM.EQ.3) IGEØM=2                                           500290
      IF(KGEØM.EQ.4) IGEØM=3                                            500300
      IF ( KGEØM.EQ.7 ) IGEØM = 1                                       500310
      IF(ISTTAB.EQ.1)  GØ TØ 7786                                       500320
      IF(ISTTAB.GE.10)GØ TØ 7786                                        500330
C     THE FØLLØWING EQUATIØNS ARE THE -THICK- SET                       500340
      GØ TØ (151,152,153),IGEØM                                         500350
C   EQUATIØNS FØR SHELLS ØF REVØLUTIØN  ( PHI  CØØRDINATE )             500360
  151 YANTH=XNUPT*YPRED(I+1)+(XK11-XNUPT**2*XK22)*(XN*YPRED(I+4)+YPRED(  500370
     1      I+5)*CS-YPRED(I+6)*SN)*X1RØ-XNTETH+XNUPT*XNTEPH             500380
      YAMTH=XNUPT*YPRED(I+3)-(XD11-XNUPT**2*XD22)*X1RØ*(X1RØ*(XN*YPRED  500390
     1      (I+4)*SN-XNSQ*YPRED(I+6))+YPRED(I+7)*CS)-XMTETH+XNUPT*XMTEPH  500400
      YAMPT=(-1.0/((RØ/XD33)+(SNSQ*X1RØ/XK33)))*(-2.0*XN*YPRED(I+7)+YPRE  500410
     1      D(I+4)*(CS1R1-CN1RØ)+XN*YPRED(I+5)*(SN1RØ+X1R1)+2.0*XN*YPRED  500420
     2      (I+6)*CS1RØ+YPRED(I)*SN/XK33)                               500430
      YAJPH = YPRED(I+2)-XNL*(XNPI*YPRED(I+7))                          500440
      YDØT(I)=R1*(-2.0*YPRED(I)*CS1RØ+XN*YANTH*X1RØ-XN*YAMTH*SN*X1RØSQ-  500450
     1         YAMPT*CS1RØ*(X1R1-SN1RØ)-XFTHLD-XMPHLD*SN1RØ)            500460
      YDØT(I+5)=R1*(YPRED(I+6)*X1R1+(1.0/(XK22-XNUTP**2*XK11))*(YPRED(I+  500470
     1          1)-XNUTP*YANTH+XNTEPH-XNUTP*XNTETH))                    500480
      YDØT(I+1) =(-YPRED(I+1)*CS1RØ+YANTH*CS1RØ-XN*YPRED(I)*X1RØ-XN*    500490
     1           YAMPT*X1RØ*(SN*X1RØ+X1R1)+YPRED(I+2)*X1R1-XFPHLD-      500500
     2            XNL*(XFPHLD*(YPRED(I+5)*CS1RØ-YPRED(I+6)*(X1R1+SN1RØ)  500510
     3            +YDØT (I+5)*X1R1)-XFZELD*YPRED(I+7)))*R1              500520
      YDØT(I+2) =(-YAJPH*CS*X1RØ-YANTH*SN1RØ-YPRED(I+1)*X1R1+XNSQ*YAMTH*  500530
     1           X1RØSQ-2.0*XN*YAMPT*CS*X1RØSQ+XN*XMPHLD*X1RØ-XFZELD-XNL  500540
     2          *(XFZELD*(YPRED(I+5)*CS*X1RØ-YPRED(I+6)*(X1R1+SN1RØ)+   500550
     3           YDØT (I+5)*X1R1)+XFPHLD*YPRED(I+7))-XNL*CS1RØ*(XNPI*   500560
     4           YPRED(I+7)))*R1                                        500570
      YDØT(I+3) = R1*(YAMTH*CS1RØ-YPRED(I+3)*CS1RØ-2.0*XN*YAMPT*X1RØ+   500580
     1            YAJPH+XMTHLD)                                         500590
      YDØT(I+4)=R1*(YPRED(I+4)*CS1RØ+XN*YPRED(I+5)*X1RØ+YPRED(I)/XK33+  500600
     1         YAMPT*SN*X1RØ/XK33)                                      500610
      YDØT(I+6)=R1*(YPRED(I+7)-YPRED(I+5)*X1R1)                         500620
```

```
      YDØT(I+7)=R1*(1.0/(XD22-XNUTP**2*XD11))*(-YPRED(I+3)+XNUTP*YAMTH-
     1          XMTEPH+XNUTP*XMTETH)
      GØTØ 9005
C     EQUATIØNS FØR CØNE
  152 YANTH=XNUPT*YPRED(I+1)+(XK11-XNUPT**2*XK22)*(X1CS/S)*(XN*YPRED(I+4
     1     )+YPRED(I+5)*CS-YPRED(I+6)*SN)-XNTETH+XNUPT*XNTEPH
      YAMTH=XNUPT*YPRED(I+3)-(1.0/S)*X1CS*(XD11-XNUPT**2*XD22)*((1.0/S)*
     1     X1CS*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+YPRED(I+7)*CS)-
     2     XMTETH+XNUPT*XMTEPH
      YAMPT=(-1.0/((S*CS/XD33)+(SN*TN/(XK33*S))))*(-2.0*XN*YPRED(I+7)-
     1     YPRED(I+4)*SN/S+XN*YPRED(I+5)*TN/S+2.0*XN*YPRED(I+6)/S+YPRED
     2     (I)*SN/XK33)
      YAJPH = YPRED(I+2)-XNL*(XNPHI*YPRED(I+7))
      YDØT(I)  =-2.0*YPRED(I)/S+XN*YANTH*X1CS/S-XN*YAMTH*SN*X1CS**2/S**2
     1          +YAMPT*TN/S**2-XFTHLD-XMPHLD*TN/S
      YDØT(I+5)=(1.0/(XK22-XNUTP**2*XK11))*(YPRED(I+1)-XNUTP*YANTH+XNTEP
     1          H-XNUTP*XNTETH)
      YDØT(I+1)= -YPRED(I+1)/S+YANTH/S-XN*YPRED(I)/(S*CS)-XN*YAMPT*SN/
     1            (S**2*CS**2)-XFPHLD-XNL*(XFPHLD*(YPRED(I+5)/S-YPRED
     2            (I+6)*TAN/S+YDØT(I+5))-XFZELD*YPRED(I+7))
      YDØT(I+2)= -YAJPH/S-YANTH*TAN/S+XNSQ*YAMTH/(S**2*CS**2)-2.0*XN*
     1          YAMPT/(S**2*CS)+XN*XMPHLD/(S*CS)-XFZELD-XNL*(XFZELD*(
     2            YPRED(I+5)/S-YPRED(I+6)*TAN/S+YDØT(I+5))+XFPHLD*YPRED
     3           (I+7))-XNL*XNPHI*YPRED(I+7)/S
      YDØT(I+3)= YAMTH/S-YPRED(I+3)/S-2.0*XN*YAMPT/(S*CS)+YAJPH+XMTHLD
      YDØT(I+4)=(1.0/S)*(YPRED(I+4)+XN*YPRED(I+5)*X1CS+YAMPT*TN/XK33)
     1          +YPRED(I)/XK33
      YDØT(I+6)=YPRED(I+7)
      YDØT(I+7)=(1.0/(XD22-XNUTP**2*XD11))*(-YPRED(I+3)+XNUTP*YAMTH-
     1          XMTEPH+XNUTP*XMTETH)
      GØ TØ 9005
C     EQUATIØNS FØR CYLINDER
  153 YANTH=XNUPT*YPRED(I+1)+(XK11-XNUPT**2*XK22)*(X1RØ*(XN*YPRED(I+4)-
     1     YPRED(I+6)))-XNTETH+XNUPT*XNTEPH
      YAMTH=XNUPT*YPRED(I+3)-(X1RØ*(XD11-XNUPT**2*XD22))*(X1RØ*(XN*YPRED
     1     (I+4)-XN**2*YPRED(I+6)))-XMTETH+XNUPT*XMTEPH
      YAMPT=(-1.0/((RØ/XD33)+(X1RØ/XK33)))*(-2.0*XN*YPRED(I+7)+XN*X1RØ*
     2     YPRED(I+5)+YPRED(I)/XK33)
      YAJPH = YPRED(I+2) - XNL * (XNPHI*YPRED(I+7))
      YDØT(I)  =XN*YANTH*X1RØ-XN*YAMTH*X1RØSQ-XFTHLD-XMPHLD*X1RØ
      YDØT(I+5)=(1.0/(XK22-XNUTP**2*XK11))*(YPRED(I+1)-XNUTP*YANTH+XNTEP
     1          H-XNUTP*XNTETH)
      YDØT(I+1) = -XN*X1RØ*YPRED(I)-XN*YAMPT*X1RØSQ-XFPHLD-XNL*(XFPHLD*
     1            (YDØT(I+5)-YPRED(I+6)*X1RØ)-XFZELD*YPRED(I+7))
      YDØT(I+2) = -YANTH*X1RØ+XNSQ*YAMTH*X1RØSQ+XN*XMPHLD*X1RØ-XFZELD-
     1            XNL*(XFZELD*(YDØT(I+5)-YPRED(I+6)*X1RØ)+XFPHLD*YPRED(
     2            I+7))
      YDØT(I+3) = -2*XN*YAMPT*X1RØ+YAJPH+XMTHLD
      YDØT(I+4)=XN*YPRED(I+5)*X1RØ+YPRED(I)/XK33+YAMPT*X1RØ/XK33
      YDØT(I+6)=YPRED(I+7)
      YDØT(I+7)=(1.0/(XD22-XNUTP**2*XD11))*(-YPRED(I+3)+XNUTP*YAMTH-XMTE
     1          PH+XNUTP*XMTETH)
      GØ TØ 9005
 7786 GØ TØ (4771,4772,4773),IGEØM
C     THE FØLLØWING EQUATIØNS ARE THE -STIO- SET
C    EQUATIØNS FØR SHELLS ØF REVØLUTIØN  ( PHI  CØØRDINATE )
 4771 YANTH= XK12*(1.0/(XK22+XC22**2/XD22))*(YPRED(I+1)+XNTPH+(XC22/XD22
     1        )*(YPRED(I+3)+XMTPH))-XNTTH+(X1RØ*XK11-XK12*XK21*X1RØ*(1.0/
     2        (XK22+XC22**2/XD22)))*(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+
     3     6)*SN)-(XC11+XK12*XC22*XD21/XD22*(1.0/(XK22+XC22**2/XD22)))*
     4        (X1RØ**2*(XN*YPRED(I+4)*SN-XN**2*YPRED(I+6))+YPRED(I+7)*CS*
```

```
     5         X1RØ)
      YAMTH =-XD12*(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+XNTPH)-XMTTH
     1         +XD12*(XK22/(XC22**2+XK22*XD22))*(YPRED(I+3)+XMTPH)+(XC11*
     2         X1RØ+XD12*XK21*X1RØ*(XC22/(XC22**2+XK22*XD22)))*(XN*YPRED(
     3         I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)+(XD11-XD12*XK22*XD21/(
     4         XC22**2+XK22*XD22))*(X1RØSQ*(XN*YPRED(I+4)*SN-XNSQ*YPRED
     5         (I+6))+YPRED(I+7)*CS*X1RØ)
      YAMPT=(-1.0/((RØ/XD33)+(SNSQ*X1RØ/XK33)))*(-2.0*XN*YPRED(I+7)+YPRE
     1       D(I+4)*(CS1R1-CN1RØ)+XN*YPRED(I+5)*(SN1RØ+X1R1)+2.0*XN*YPRED
     2       (I+6)*CS1RØ+YPRED(I)*SN/XK33)
      YAJPH = YPRED(I+2)-XNL*(XNPI*YPRED(I+7))
      YDØT(I)=R1*(-2.0*YPRED(I)*CS1RØ+XN*YANTH*X1RØ-XN*YAMTH*SN*X1RØSQ-
     1         YAMPT*CS1RØ*(X1R1-SN1RØ)-XFTHLD-XMPHLD*SN1RØ)
      YDØT (I+5)=R1*(YPRED(I+6)*X1R1+(1.0/(XK22+XC22**2/XD22))*(YPRED(I+
     1            1)+XNTPH+(XC22/XD22)*(YPRED(I+3)+XMTPH)-XK21*X1RØ*(XN*
     2            YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)-(XC22*XD21/XD22
     3            )*(X1RØSQ*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+YPRED(I+7)
     4            *CS*X1RØ)))
      YDØT(I+1) =(-YPRED(I+1)*CS1RØ+YANTH*CS1RØ-XN*YPRED(I)*X1RØ-XN*
     1            YAMPT*X1RØ*(SN*X1RØ+X1R1)+YPRED(I+2)*X1R1-XFPHLD-
     2             XNL*(XFPHLD*(YPRED(I+5)*CS1RØ-YPRED(I+6)*(X1R1+SN1RØ)
     3             +YDØT (I+5)*X1R1)-XFZELD*YPRED(I+7)))*R1
      YDØT(I+2) =(-YAJPH*CS*X1RØ-YANTH*SN1RØ-YPRED(I+1)*X1R1+XNSQ*YAMTH*
     1            X1RØSQ-2.0*XN*YAMPT*CS*X1RØSQ+XN*XMPHLD*X1RØ-XFZELD-XNL
     2            *(XFZELD*(YPRED(I+5)*CS*X1RØ-YPRED(I+6)*(X1R1+SN1RØ)+
     3            YDØT (I+5)*X1R1)+XFPHLD*YPRED(I+7))-XNL*CS1RØ*(XNPI*
     4            YPRED(I+7)))*R1
      YDØT(I+3) = R1*(YAMTH*CS1RØ-YPRED(I+3)*CS1RØ-2.0*XN*YAMPT*X1RØ+
     1             YAJPH+XMTHLD)
      YDØT(I+4)=R1*(YPRED(I+4)*CS1RØ+XN*YPRED(I+5)*X1RØ+YPRED(I)/XK33+
     1           YAMPT*SN*X1RØ/XK33)
      YDØT(I+6)=R1*(YPRED(I+7)-YPRED(I+5)*X1R1)
      YDØT(I+7)=R1*((-XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+XNTPH-(XK21/
     1           RØ)*(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN))
     2           +(XK22/(XC22**2+XK22*XD22))*(YPRED(I+3)+XMTPH)-(XK22*
     3           XD21/(XC22**2+XK22*XD22))*(X1RØSQ*(XN*YPRED(I+4)*SN-XNSQ
     4           *YPRED(I+6))+YPRED(I+7)*CS*X1RØ))
      GØ TØ 9005
C     EQUATIØNS FØR CØNE
 4772 YANTH= XK12*(1.0/(XK22+XC22**2/XD22))*(YPRED(I+1)+XNTPH+(XC22/XD22
     1        )*(YPRED(I+3)+XMTPH))-XNTTH+(1.0/(CS*S))*(XK11-XK12*XK21*(
     2        1.0/(XK22+XC22**2/XD22)))*(XN*YPRED(I+4)+YPRED(I+5)*CS-
     3        YPRED(I+6)*SN)-(XC11+(XK12*XD21*XC22/XD22)*(1.0/(XK22+XC22*
     4        *2/XD22)))*((1.0/(S**2*CS**2))*(XN*YPRED(I+4)*SN-XNSQ*YPRED
     5        (I+6))+YPRED(I+7)/S)
      YAMTH =-XD12*(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+XNTPH)-XMTTH+
     1         XD12*(XK22/(XC22**2+XK22*XD22))*(YPRED(I+3)+XMTPH)+(XC11/
     2         (S*CS)+XD12*XK21/(S*CS))*(XC22/(XC22**2+XK22*XD22))*(XN*
     3         YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)+(XD11-XD12*XK22*
     4         XD21/(XC22**2+XK22*XD22))*((1.0/(S*CS)**2)*(XN*YPRED(I+4)*
     5         SN-XNSQ*YPRED(I+6))+YPRED(I+7)/S)
      YAMPT=(-1.0/((S*CS/XD33)+(SN*TN/(XK33*S))))*(-2.0*XN*YPRED(I+7)-
     1       YPRED(I+4)*SN/S+XN*YPRED(I+5)*TN/S+2.0*XN*YPRED(I+6)/S+YPRED
     2       (I)*SN/XK33)
      YAJPH = YPRED(I+2)-XNL*(XNPHI*YPRED(I+7))
      YDØT(I)  =-2.0*YPRED(I)/S+XN*YANTH*X1CS/S-XN*YAMTH*SN*X1CS**2/S**2
     1          +YAMPT*TN/S**2-XFTHLD-XMPHLD*TN/S
      YDØT(I+5)=(1.0/(XK22+XC22**2/XD22))*(YPRED(I+1)+XNTPH+(XC22/XD22)*
     1           (YPRED(I+3)+XMTPH)-(XK21/(S*CS))*(XN*YPRED(I+4)+YPRED(
     2           I+5)*CS-YPRED(I+6)*SN)-(XC22*XD21/XD22)*((1.0/(S**2*CS**
     3           2))*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+YPRED(I+7)/S))
```

```
      YDØT(I+1)= -YPRED(I+1)/S+YANTH/S-XN*YPRED(I)/(S*CS)-XN*YAMPT*SN/
     1           (S**2*CS**2)-XFPHLD-XNL*(XFPHLD*(YPRED(I+5)/S-YPRED
     2           (I+6)*TAN/S+YDØT(I+5))-XFZELD*YPRED(I+7))
      YDØT(I+2)= -YAJPH/S-YANTH*TAN/S+XNSQ*YAMTH/(S**2*CS**2)-2.0*XN*
     1          YAMPT/(S**2*CS)+XN*XMPHLD/(S*CS)-XFZELD-XNL*(XFZELD*(
     2           YPRED(I+5)/S-YPRED(I+6)*TAN/S+YDØT(I+5))+XFPHLD*YPRED
     3          (I+7))-XNL*XNPHI*YPRED(I+7)/S
      YDØT(I+3)= YAMTH/S-YPRED(I+3)/S-2.0*XN*YAMPT/(S*CS)+YAJPH+XMTHLD
      YDØT(I+4)=(1.0/S)*(YPRED(I+4)+XN*YPRED(I+5)*X1CS+YAMPT*TN/XK33)
     1          +YPRED(I)/XK33
      YDØT(I+6)=YPRED(I+7)
      YDØT(I+7)=-(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+XNTPH-XK21*(XN*
     1          YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)/(S*CS))+
     2          (XK22/(XC22**2+XK22*XD22))*(YPRED(I+3)+XMTPH)-(XK22*XD21
     3          /(XC22**2+XK22*XD22))*((1.0/(S*CS))**2)*(XN*YPRED(I+4)*SN
     4          -XN**2*YPRED(I+6))+YPRED(I+7)/S)
      GØ TØ 9005
C     EQUATIØNS FØR CYLINDER
 4773 YANTH= XK12*(1.0/(XK22+XC22**2/XD22))*(YPRED(I+1)+XNTPH+(XC22/XD22
     1       )*(YPRED(I+3)+XMTPH))-XNTTH+(X1RØ*(XK11-XK12*XK21*(1.0/(
     2       XK22+XC22**2/XD22))))*(XN*YPRED(I+4)-YPRED(I+6))-(XC11+(
     3       XK12*XC22*XD21/XD22)*(1.0/(XK22+XC22**2/XD22)))*(X1RØ**2*(
     4       XN*YPRED(I+4)-XNSQ*YPRED(I+6)))
      YAMTH =-XD12*(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+XNTPH)-XMTTH+
     1        XD12*(XK22/(XC22**2+XK22*XD22))*(YPRED(I+3)+XMTPH)+(XC11*
     2        X1RØ+XD12*XK21*X1RØ*(XC22/(XC22**2+XK22*XD22)))*(XN*YPRED
     3        (I+4)-YPRED(I+6))+(XD11-XD12*XK22*XD21/(XC22**2+XK22*XD22)
     4        )*(X1RØSQ*(XN*YPRED(I+4)-XNSQ*YPRED(I+6)))
      YAMPT=(-1.0/((RØ/XD33)+(X1RØ/XK33)))*(-2.0*XN*YPRED(I+7)+XN*X1RØ*
     1      YPRED(I+5)+YPRED(I)/XK33)
      YAJPH = YPRED(I+2) - XNL * (XNPHI*YPRED(I+7))
      YDØT(I)  =XN*YANTH*X1RØ-XN*YAMTH*X1RØSQ-XFTHLD-XMPHLD*X1RØ
      YDØT (I+5) =(1.0/(XK22+XC22**2/XD22))*(YPRED(I+1)+XNTPH+(XC22/XD22
     1           )*(YPRED(I+3)+XMTPH)-(XK21*X1RØ)*(XN*YPRED(I+4)-YPRED
     2      (I+6))-(XC22*XD21/XD22)*(X1RØSQ*(XN*(YPRED(I+4)-XN*YPRE
     3           D(I+6)))))
      YDØT(I+1) = -XN*X1RØ*YPRED(I)-XN*YAMPT*X1RØSQ-XFPHLD-XNL*(XFPHLD*
     1            (YDØT(I+5)-YPRED(I+6)*X1RØ)-XFZELD*YPRED(I+7))
      YDØT(I+2) = -YANTH*X1RØ+XNSQ*YAMTH*X1RØSQ+XN*XMPHLD*X1RØ-XFZELD-
     1           XNL*(XFZELD*(YDØT(I+5)-YPRED(I+6)*X1RØ)+XFPHLD*YPRED(
     2           I+7))
      YDØT(I+3) = -2*XN*YAMPT*X1RØ+YAJPH+XMTHLD
      YDØT(I+4)=XN*YPRED(I+5)*X1RØ+YPRED(I)/XK33+YAMPT*X1RØ/XK33
      YDØT(I+6)=YPRED(I+7)
      YDØT(I+7)=-(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+XNTPH-XK21*X1RØ*
     9          (
     1          XN*YPRED(I+4)-YPRED(I+6)))+(XK22/(XC22**2+XK22*XD22))*(
     2          YPRED(I+3)+XMTPH)-(XK22*XD21/(XC22**2+XK22*XD22))*(
     3          X1RØSQ*(XN*YPRED(I+4)-XNSQ*YPRED(I+6)))
 9005 CØNTINUE
      RETURN
       END
```


ENTRY
IF IANLYZ .NE.1
YES
XNL = 1
NØ
XNL = 0
IF KGEOM = 1, 2, 5, 6, OR 7 IGEOM = 1
IF KGEOM = 3, IGEOM = 2
IF KGEOM = 4, IGEOM = 3
RWAF OR ISGR SET
IF IGEOM =
1
2
3
ϕ COOR. EQUATIONS
CONE EQUATIONS
CYLINDER EQUATIONS
RETURN

```
FØR,IS DIFF2,DIFF2
      SUBRØUTINE DIFF2
      INTEGER SAVJTC,SAVSTP,Q,THICK
      CØMMØN STØRY(16),TALE(16),XMAT(110,10),STD(10),SADUS(30),RADUS(30)
      CØMMØN TADUS(30),UADUS(30),SAVTIC(900)
      CØMMØN XN,TEFREE,TIC,PHI,STØP,RESTØP,RTICK,G1,XNL
      CØMMØN NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)
      CØMMØN JRSTØP(30),NREG,NSEGTL,NMPT,MATPRP,NCUPLE,NRGEND,NSYM,NRG
      CØMMØN NRC,NSC,NIX,IERRØR,IØUT,MAT,KGEØM,IGEØM,ITYPE,ISTTAB,KELVIN
      CØMMØN IBEGIN,NPRØB,NHARM,NSEG,NERRØR, Q ,NSMAX,THICK
      EQUIVALENCE (XMTTH,XMTETH),(XMTPH,XMTEPH),(XNTTH,XNTETH),
     1            (XNTPH,XNTEPH)
      EQUIVALENCE  (XNPHI,XNPI)
      DØUBLE PRECISIØN YPRED
      CØMMØN /EQUAZN/ YPRED(144),YDØT(144),YASAVE(144),
     1                YANTH,YAMTH,YAMPT,YAJPH,
     2                S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,
     3                X1RØ,X1RØSQ,X1SNRØ,X1CSRØ,CN1RØ,SN1RØ,CS1RØ,
     4                X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RØ,BESQ,
     5    RØSQ,XNSQ,BETA,R1,R2,S1,R1DØT,
     6                XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,
     7  XMTHLD,XMPHLD,ETHET(2),EPHI(2),XGPT(2),ALPHTH(2),ALPHPH(2),
     8                XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,
     9                XK11,XK12,XK21,XK22,XK33,XD11,
     A  XNPHI,M,I,         BETTA,XC16,XC14,XC25
      IGEØM = 0
      IF (KGEØM.EQ.1.ØR.KGEØM.EQ.2.ØR.KGEØM.EQ.5.ØR.KGEØM.EQ.6) IGEØM =1
      IF (KGEØM.EQ.3) IGEØM=2
      IF(KGEØM.EQ.4) IGEØM=3
      IF ( KGEØM.EQ.7 ) IGEØM = 1
 7447 GØ TØ (7341,7342,7343),IGEØM
C     THE FØLLØWING EQUATIØNS ARE THE -RWAF- SET
C     EQUATIØNS FØR SHELLS ØF REVØLUTIØN ( PHI CØØRDINATE )
 7341 YANTH = (YPRED(I+1)+XNTPH)*(XC15*XC22+XD22*XK12)/(XK22*XD22+
     1 XC22*XC22)-XNTTH+(XK12*XC22-XK22*XC15)*(YPRED(I+3)+XMTPH)/
     2 (XC22*XC22+XK22*XD22)+X1RØ*(XN*YPRED(I+4)+YPRED(I+5)*CS-
     3 YPRED(I+6)*SN)*(XK11+(XC15*(XC15*XK22-2.0*XK12*XC22)-XK12*XK12*
     4 XD22)/(XK22*XD22+XC22*XC22))+(X1RØSQ*(XN*YPRED(I+4)*SN-XNSQ
     5 *YPRED(I+6))+X1RØ*YPRED(I+7)*CS)*(-XC11+(XC15*XC15*XC22+
     6 XC15*(XK12*XD22+XK22*XD12)-XK12*XD12*XC22)/(XK22*XD22+XC22*XC22))
      YAMTH = (YPRED(I+3)+XNTPH)*(XC15*XC22+XK22*XD12)/(XK22*XD22+
     1 XC22*XC22)+(YPRED(I+1)+XNTPH)*(XD22*XC15-XD12*XC22)/(XD22*XK22+
     2 XC22*XC22)-XMTTH+(X1RØSQ*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+
     3 X1RØ*YPRED(I+7)*CS)*(XD11-(XD12*XD12*XK22+XC15*(2.0*XC22*XD12-
     3 XC15*
     4 XD22))/(XC22*XC22+XK22*XD22))+X1RØ*(XN*YPRED(I+4)+YPRED(I+5)*CS-
     5 YPRED(I+6)*SN)*(XC11+(XD12*XC22*XK12-XC15*(XC15*XC22+XD12*XK22+
     6 XD22*XK12))/(XC22*XC22+XK22*XD22))
      YAMPT = (1.0/(XC16*SN*X1RØ-XK33-SN*X1RØ*(XD33*SN/(      RØ)-XC16)))
     1         *((XK33*XD33-XC16**2)*X1RØ*(-2.0*XN*YPRED(I+7)+YPRED(I+4)*
     2         (CS*X1R1-CN1RØ)+XN*YPRED(I+5)*(X1R1+SN1RØ)+2.0*XN*YPRED
     3         (I+6)*CS*X1RØ)+YPRED(I)*(XD33*SN*X1RØ-XC16))
      YAJPH = YPRED(I+2)-XNL*(XNPI*YPRED(I+7))
      YDØT(I)=R1*(-2.0*YPRED(I)*CS1RØ+XN*YANTH*X1RØ-XN*YAMTH*SN*X1RØSQ-
     1         YAMPT*CS1RØ*(X1R1-SN1RØ)-XFTHLD-XMPHLD*SN1RØ)
      YDØT(I+5)=YPRED(I+6)+R1*(XD22*(YPRED(I+1)+XNTPH)+XC22*(YPRED(I+3)
     1+XMTPH)-X1RØ*(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)*(XK12*
     2XD22+XC15*XC22)-(X1RØSQ*(XN*YPRED(I+4)-XNSQ*YPRED(I+6))+X1RØ*
     3YPRED(I+7)*CS)*(XC22*XD12-XC15*XD22))/(XK22*XD22+XC22**2)
      YDØT(I+1) =(-YPRED(I+1)*CS1RØ+YANTH*CS1RØ-XN*YPRED(I)*X1RØ-XN*
     1           YAMPT*X1RØ*(SN*X1RØ+X1R1)+YPRED(I+2)*X1R1-XFPHLD-
```

```
     2            XNL*(XFPHLD*(YPRED(I+5)*CS1RØ-YPRED(I+6)*(X1R1+SN1RØ)
     3            +YDØT (I+5)*X1R1)-XFZELD*YPRED(I+7)))*R1
      YDØT(I+2) =(-YAJPH*CS*X1RØ-YANTH*SN1RØ-YPRED(I+1)*X1R1+XNSQ*YAMTH*
     1           X1RØSQ-2.0*XN*YAMPT*CS*X1RØSQ+XN*XMPHLD*X1RØ-XFZELD-XNL
     2          *(XFZELD*(YPRED(I+5)*CS*X1RØ-YPRED(I+6)*(X1R1+SN1RØ)+
     3           YDØT (I+5)*X1R1)+XFPHLD*YPRED(I+7))-XNL*CS1RØ*(XNPI*
     4           YPRED(I+7)))*R1
      YDØT(I+3) = R1*(YAMTH*CS1RØ-YPRED(I+3)*CS1RØ-2.0*XN*YAMPT*X1RØ+
     1            YAJPH+XMTHLD)
      YDØT(I+4) =R1*(YPRED(I+4)*CS*X1RØ+XN*YPRED(I+5)*X1RØ+(1.0/(XK33-
     1           XC16**2/XD33))*(YPRED(I)+YAMPT*(SN*X1RØ-XC16/XD33)))
      YDØT(I+6)=R1*(YPRED(I+7)-YPRED(I+5)*X1R1)
      YDØT(I+7)=R1*(XK22*(YPRED(I+3)+XMTPH)-XC22*(YPRED(I+1)+XNTPH)+X1RØ
     I*(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)*(XK12*XC22-XK22*XC15)
     2-(X1RØSQ*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+X1RØ*YPRED(I+7)*CS)*
     3(XC15*XC22+XK22*XD12))/(XC22**2+XK22*XD22)
      GØ TØ 9005
C     EQUATIØNS FØR CØNE
 7342 YANTH = (YPRED(I+1)+XNTPH)*(XC15*XC22+XD22*XK12)/(XK22*XD22+
     1 XC22*XC22)-XNTTH+(XK12*XC22-XK22*XC15)*(YPRED(I+3)+XMTPH)/
     2 (XC22*XC22+XK22*XD22)+(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)
     3 *SN)/(S*CS)*(XK11+(XC15*(XC15*XK22-2.0*XK12*XC22)-XK12*XK12*
     4 XD22)/(XK22*XD22+XC22*XC22))+((XN*YPRED(I+4)*SN-XNSQ*
     5 YPRED(I+6))/(S*S*CSSQ)+YPRED(I+7)/S)*(-XC11+(XC15*XC15*XC22+
     6 XC15*(XK12*XD22+XK22*XD12)-XK12*XD12*XC22)/(XK22*XD22+XC22*XC22))
      YAMTH = (YPRED(I+3)+XNTPH)*(XC15*XC22+XK22*XD12)/(XK22*XD22+
     1 XC22*XC22)+(YPRED(I+1)+XNTPH)*(XD22*XC15-XD12*XC22)/(XD22*XK22+
     2 XC22*XC22)-XMTTH+(1.0/(S*S*CSSQ)*(-XNSQ*YPRED(I+6)+XN*YPRED(I+4)*
     3 SN)+YPRED(I+7)/S)*(XD11-(XD12*XD12*XK22+XC15*(2.0*XC22*XD12-XC15*
     4 XD22))/(XC22*XC22+XK22*XD22))+1.0/(S*CS)*(XN*YPRED(I+4)+
     5 YPRED(I+5)*CS-
     5 YPRED(I+6)*SN)*(XC11+(XD12*XC22*XK12-XC15*(XC15*XC22+XD12*XK22+
     6 XD22*XK12))/(XC22*XC22+XK22*XD22))
      YAMPT =((XC16*TAN/S-XK33-(TAN/S)*(XD33*TAN/S-XC16))**(-1))*((XK33*
     1       XD33-XC16**2)*(1.0/(S*CS))*(-2.0*XN*YPRED(I+7)-YPRED(I+4)*
     2        SN/S+XN*YPRED(I+5)*TAN/S+2.0*XN*YPRED(I+6)/S)+YPRED(I)*(
     3       XD33*TAN/S-XC16))
      YAJPH = YPRED(I+2)-XNL*(XNPHI*YPRED(I+7))
      YDØT(I)  =-2.0*YPRED(I)/S+XN*YANTH*X1CS/S-XN*YAMTH*SN*X1CS**2/S**2
     1          +YAMPT*TN/S**2-XFTHLD-XMPHLD*TN/S
      YDØT(I+5)=(XD22*(YPRED(I+1)+XNTPH)+XC22*(YPRED(I+3)+XMTPH)-(XK12*
     1          XD22+XC15*XC22)*(1.0/(S*CS)*(XN*YPRED(I+4)+YPRED(I+5)*
     2          CS-YPRED(I+6)*SN))-(XC22*XD12-XC15*XD22)*((-XNSQ*
     3          YPRED(I+6)+XN*YPRED(I+4)*SN)/(S*S*CSSQ)+YPRED(I+7)/S))
     4          /(XK22*XD22+XC22*XC22)
      YDØT(I+1)= -YPRED(I+1)/S+YANTH/S-XN*YPRED(I)/(S*CS)-XN*YAMPT*SN/
     1            (S**2*CS**2)-XFPHLD-XNL*(XFPHLD*(YPRED(I+5)/S-YPRED
     2            (I+6)*TAN/S+YDØT(I+5))-XFZELD*YPRED(I+7))
      YDØT(I+2)= -YAJPH/S-YANTH*TAN/S+XNSQ*YAMTH/(S**2*CS**2)-2.0*XN*
     1          YAMPT/(S**2*CS)+XN*XMPHLD/(S*CS)-XFZELD-XNL*(XFZELD*(
     2            YPRED(I+5)/S-YPRED(I+6)*TAN/S+YDØT(I+5))+XFPHLD*YPRED
     3           (I+7))-XNL*XNPHI*YPRED(I+7)/S
      YDØT(I+3)= YAMTH/S-YPRED(I+3)/S-2.0*XN*YAMPT/(S*CS)+YAJPH+XMTHLD
      YDØT (I+4) = YPRED(I+4)/S+XN*YPRED(I+5)/(S*CS)+(1.0/(XK33-XC16**2/
     1             XD33))*(YPRED(I)+YAMPT*(TAN/S-XC16/XD33))
      YDØT(I+6)=YPRED(I+7)
      YDØT(I+7)=(XK22*(YPRED(I+3)+XMTPH)-XC22*(YPRED(I+1)+XNTPH)+
     1          (XK12*XC22-XK22*XC15)*(1.0/(S*CS)*(XN*YPRED(I+4)+
     2          YPRED(I+5)*CS-YPRED(I+6)*SN))-(XC15*XC22+XK22*XD12)*
     3          ((-XNSQ*YPRED(I+6)+XN*YPRED(I+4)*SN)/(S*S*CSSQ)+
     4          YPRED(I+7)/S))/(XK22*XD22+XC22*XC22)
```

```
      GØ TØ 9005
C     EQUATIØNS FØR CYLINDER
 7343 YANTH = (YPRED(I+1)+XNTPH)*(XC15*XC22+XD22*XK12)/(XK22*XD22+
     1 XC22*XC22)-XNTTH+(XK12*XC22-XK22*XC15)*(YPRED(I+3)+XMTPH)/
     2 (XC22*XC22+XK22*XD22)+X1RØ*(XN*YPRED(I+4)-
     3 YPRED(I+6))*(XK11+(XC15*(XC15*XK22-2.0*XK12*XC22)-XK12*XK12*
     4 XD22)/(XK22*XD22+XC22*XC22))+(X1RØSQ*(XN*YPRED(I+4)-XNSQ
     5 *YPRED(I+6)))*(-XC11+(XC15*XC15*XC22+
     6 XC15*(XK12*XD22+XK22*XD12)-XK12*XD12*XC22)/(XK22*XD22+XC22*XC22))
      YAMTH = (YPRED(I+3)+XNTPH)*(XC15*XC22+XK22*XD12)/(XK22*XD22+
     1 XC22*XC22)+(YPRED(I+1)+XNTPH)*(XD22*XC15-XD12*XC22)/(XD22*XK22+
     2 XC22*XC22)-XMTTH+X1RØSQ*(XN*YPRED(I+4)-XNSQ*YPRED(I+6))
     3 *(XD11-(XD12*XD12*XK22+XC15*(2.0*XC22*XD12-XC15*
     4 XD22))/(XC22*XC22+XK22*XD22))+X1RØ*(XN*YPRED(I+4)-
     5 YPRED(I+6))*(XC11+(XD12*XC22*XK12-XC15*(XC15*XC22+XD12*XK22+
     6 XD22*XK12))/(XC22*XC22+XK22*XD22))
      YAMPT=(1/(XC16*X1RØ-XK33-X1RØ*(XD33*X1RØ-XC16)))*((XK33*XD33-XC16
     1      **2)*X1RØ*(-2*XN*YPRED(I+7)+XN*X1RØ*YPRED(I+5))+YPRED(I)*(
     2      XD33*X1RØ-XC16))
      YAJPH = YPRED(I+2) - XNL * (XNPHI*YPRED(I+7))
      YDØT(I)  =XN*YANTH*X1RØ-XN*YAMTH*X1RØSQ-XFTHLD-XMPHLD*X1RØ
      YDØT(I+5)=(XD22*(YPRED(I+1)+XNTPH)+XC22*(YPRED(I+3)+XMTPH)-X1RØ*
     1(XN*YPRED(I+4)-YPRED(I+6))*(XK12*XD22+XC15*XC22)-X1RØSQ*(XN*YPRED
     2(I+4)-XNSQ*YPRED(I+6))*(XC22*XD12-XC15*XD22))/(XK22*XD22+XC22**2)
      YDØT(I+1) = -XN*X1RØ*YPRED(I)-XN*YAMPT*X1RØSQ-XFPHLD-XNL*(XFPHLD*
     1          (YDØT(I+5)-YPRED(I+6)*X1RØ)-XFZELD*YPRED(I+7))
      YDØT(I+2) = -YANTH*X1RØ+XNSQ*YAMTH*X1RØSQ+XN*XMPHLD*X1RØ-XFZELD-
     1          XNL*(XFZELD*(YDØT(I+5)-YPRED(I+6)*X1RØ)+XFPHLD*YPRED(
     2          I+7))
      YDØT(I+3) = -2*XN*YAMPT*X1RØ+YAJPH+XMTHLD
      YDØT(I+4)=(XN*YPRED(I+5)/RØ)+(1/(XK33-XC16**2/XD33))*(YPRED(I)+
     1        YAMPT*(X1RØ-XC16/XD33))
      YDØT(I+6)=YPRED(I+7)
      YDØT(I+7)=(XK22*(YPRED(I+3)+XMTPH)-XC22*(YPRED(I+1)+XNTPH)+X1RØ*
     1(XN*YPRED(I+4)-YPRED(I+6))*(XK12*XC22-XK22*XC15)-X1RØSQ*(XN*YPRED
     2(I+4)-XNSQ*YPRED(I+6))*(XC15*XC22+XK22*XD12))/(XC22**2+XK22*XD22)
 9005 CØNTINUE
      RETURN
      END
```

SUBROUTINE SEGMAT

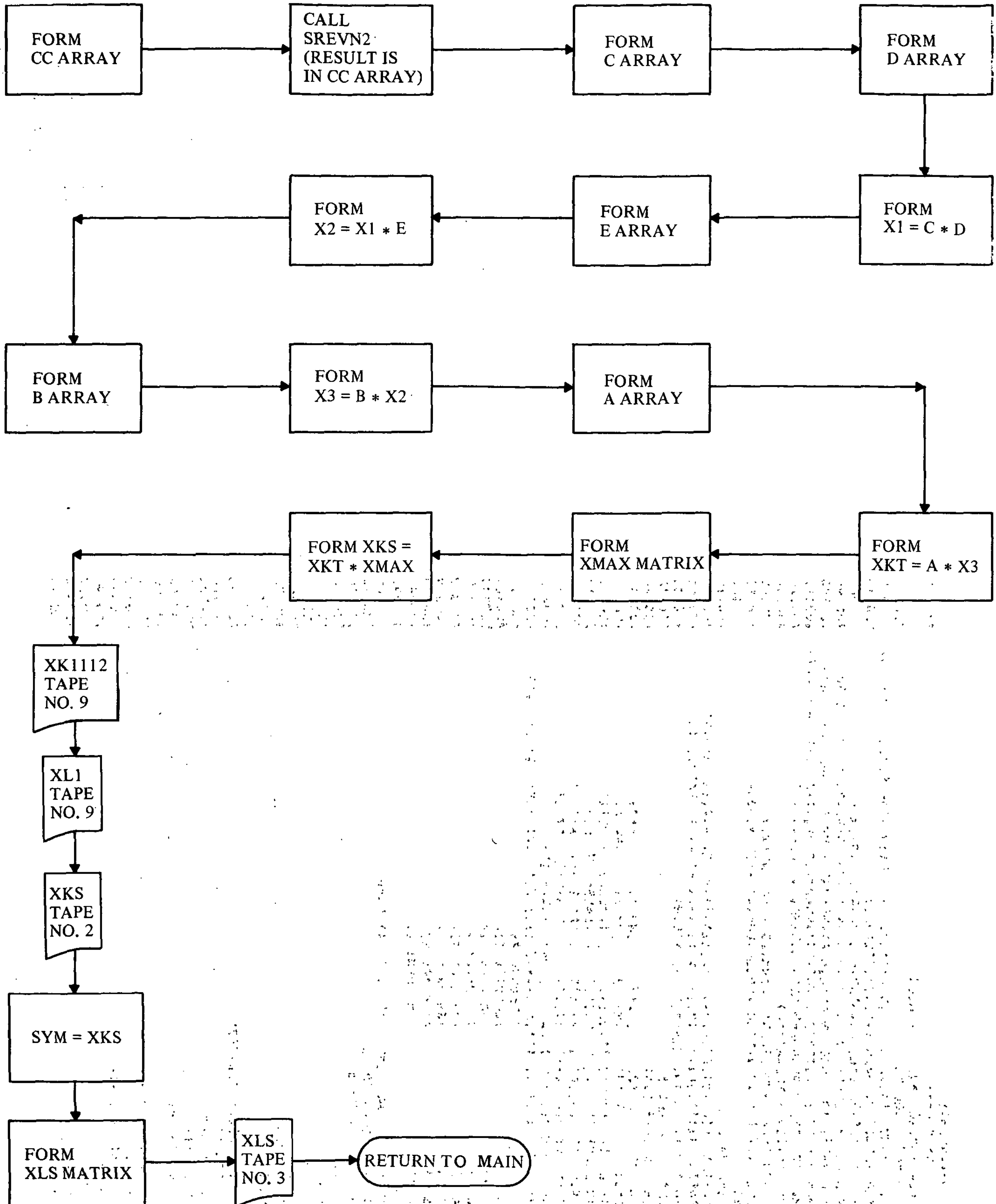
The results of the subroutine link, RIEMAN, are passed through the label common area, LYCORR, to this subroutine. SEGMAT places the elements of the YCORR array into several double-subscripted arrays, forms some coordinate transformatic arrays, and calls subroutine SREVN2 for double precision matrix inversion.

As a result of appropriate matrix operations this subroutine produces a segment stiffness matrix, the XKS array, and a segment load matrix, the XLS array, for each segment. SEGMAT also orients each segment into the global coordinate system of the structure as a result of the matrix operations.

Subroutine SREVN2

SREVN2 is a subroutine called by SEGMAT to invert a real, double-precision, in-core matrix utilizing Gauss-Jordan elimination with partial pivoting.

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
SNI	si
SNJ	sj
CSI	ci
CSJ	cj
A MATRIX	$\left[\begin{array}{c:c} IFT & 0 \\ \hdashline 0 & JFT \end{array}\right]$
B MATRIX	$\left[\begin{array}{c:c:c} 0 & I_4 & 0 \\ \hdashline X_1 & X_2 & X_3 \end{array}\right]$
C MATRIX	$\left[\begin{array}{c:c:c} I_4 & 0 & 0 \\ \hdashline 0 & Y_2^{-1} & 0 \\ \hdashline 0 & 0 & I_p \end{array}\right]$
D MATRIX	$\left[\begin{array}{c:c:c} I_4 & 0 & 0 \\ \hdashline -Y_1 & JDT^T & -Y_3 \\ \hdashline 0 & 0 & I_p \end{array}\right]$
E MATRIX	$\left[\begin{array}{c:c:c} IDT^T & 0 & 0 \\ \hdashline 0 & I_4 & 0 \\ \hdashline 0 & 0 & I_p \end{array}\right]$
XKT MATRIX	$\left[\begin{array}{c:c} k & \ell \end{array}\right]$
XMAX MATRIX	$\left[\begin{array}{c:c} 2\pi r_0(i) & \\ \hdashline & 2\pi r_0(j) \end{array}\right]$
XKS MATRIX	${}_s\left[\hat{k}\right]^{(n)}$
XLS MATRIX	${}_s\left[\hat{\ell}\right]^{(n)}$


FORM CC ARRAY
CALL SREVN2 (RESULT IS IN CC ARRAY)
FORM C ARRAY
FORM D ARRAY
FORM X1 = C * D
FORM E ARRAY
FORM X2 = X1 * E
FORM B ARRAY
FORM X3 = B * X2
FORM A ARRAY
FORM XKT = A * X3
FORM XMAX MATRIX
FORM XKS = XKT * XMAX
XK1112 TAPE NO. 9
XL1 TAPE NO. 9
XKS TAPE NO. 2
SYM = XKS
FORM XLS MATRIX
XLS TAPE NO. 3
RETURN TO MAIN

```
FØR,IS SEGMAT,SEGMAT
      SUBRØUTINE SEGMAT
      INTEGER SAVJTC,SAVSTP,Q,THICK
      DØUBLE PRECISIØN CC
      CØMMØN STØRY(16),TALE(16),XMAT(110,10),STD(10),SADUS(30),RADUS(30)
      CØMMØN TADUS(30),UADUS(30),SAVTIC(900)
      CØMMØN XN,TEFREE,TIC,PHI,STØP,RESTØP,RTICK,G1,XNL
      CØMMØN NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)
      CØMMØN JRSTØP(30),NREG,NSEGTL,NMPT,MATPRP,NCUPLE,NRGEND,NSYM,NRG
      CØMMØN NRC,NSC,NIX,IERRØR,IØUT,MAT,KGEØM,IGEØM,ITYPE,ISTTAB,KELVIN
      CØMMØN IBEGIN,NPRØB,NHARM,NSEG,NERRØR, Q ,NSMAX,THICK
      CØMMØN /LYCØRR/ YCØRR(144)
      CØMMØN/HARMØN/ NHRC,IRCNT, HARM(25), HARPØS(25),
     1IHCLUE(2),THEANG(36),NANG,LUNSUM,LUN1,ISWICH,NUMØUT
     2,NHAR
      INTEGER HARPØS
      DIMENSIØN C(18,18),CC(4,4),D(18,18),E(18,18),B(8,18),A(8,8)
      DIMENSIØN X1(18,18),X2(18,18),X3(8,18),XKT(8,18),XMAX(8,18)
      DIMENSIØN XKS(8,18),XLS(8,10),SYM(8,8)
      DIMENSIØN  DEAD(4)
      DIMENSIØN LABEL(16)
      DIMENSIØN     N1(2)     ,N2(2)     ,N3(2)     ,N4(2)
      DIMENSIØN     N5(2)     ,N6(2)     ,N7(2)     ,N8(2)
      EQUIVALENCE (LABEL( 1),N1(1))    , (LABEL( 3),N2(1))
      EQUIVALENCE (LABEL( 5),N3(1))    , (LABEL( 7),N4(1))
      EQUIVALENCE (LABEL( 9),N5(1))    , (LABEL(11),N6(1))
      EQUIVALENCE (LABEL(13),N7(1))    , (LABEL(15),N8(1))
      EQUIVALENCE (C(1),E(1),X3(1),XMAX(1),XLS(1))
      EQUIVALENCE (X2(1),D(1),A(1),XKS(1)),(X1(1),B(1),XKT(1),SYM(1))
      DATA N1                 /8HFØRCE T1/
      DATA N2                 /8HFØRCE Z1/
      DATA N3                 /8HFØRCE R1/
      DATA N4                 /8HMØMENT 1/
      DATA N5                 /8HFØRCE T2/
      DATA N6                 /8HFØRCE Z2/
      DATA N7                 /8HFØRCE R2/
      DATA N8                 /8HMØMENT 2/
      IPR = 1
      IF (Q.EQ. 1 .AND. IHCLUE(2) .EQ. 1)IPR=0
      IF(IPR.EQ. 0)GØ TØ 33
      IF(Q.NE. 1)GØ TØ 31
      WRITE(6,32)
   32 FØRMAT(////)
      GØ TØ 33
   31 CØNTINUE
      WRITE(6,1726)
 1726 FØRMAT(1H1)
   33 A1 = G1
      GØTØ (601,602,603),IGEØM
  601 SNI = SIN(TIC)
      SNJ = SIN(STØP)
      CSI = CØS(TIC)
      CSJ = CØS(STØP)
      GØTØ 1
  602 SNI = CØS(1.570796-A1)
      SNJ = SNI
      CSI = SIN(1.570796-A1)
      CSJ = CSI
      GØTØ 1
  603 SNI = 1.0
      SNJ = 1.0
```

```
      CSI = 0.0
      CSJ = 0.0
    1 JJ = 8+NPRØB
      DØ 111 J=1,18
      DØ 111 I=1,18
  111 C(I,J)=0.0
      K=28
      DØ 112 J=1,4
      K=K+8
      L=K
      DØ 112 I=1,4
      L=L+1
  112 CC(I,J)=YCØRR(L)
      CALL SREVN2 (CC,4,DEAD,4,NIX)
      IF (NIX.NE.0) GØTØ 8120
      J1=0
      DØ 113 J=5,8
      J1=J1+1
      I1=0
      DØ 113 I=5,8
      II=II+1
  113 C(I,J)=CC(II,J1)
      DØ 114 IJ=1,4
  114 C(IJ,IJ)=1.0
      DØ 115 IJ=9,JJ
  115 C(IJ,IJ)=1.0
      DØ 116 J=1,18
      DØ 116 I=1,18
  116 D(I,J)=0.0
      DØ 117 IJ=1,4
  117 D(IJ,IJ)=1.0
      I=5
      D(I,I)=1.0
      D(I+1,I+1)=-SNJ
      D(I+2,I+2)=-SNJ
      D(I+3,I+3)=1.0
      D(I+1,I+2)= CSJ
      D(I+2,I+1)=-CSJ
      DØ 218 IJ=9,JJ
  218 D(IJ,IJ)=1.0
      K=-4
      DØ 118 J=1,4
      K=K+8
      L=K
      DØ 118 I=5,8
      L=L+1
  118 D(I,J)= -YCØRR(L)
      K=60
      DØ 119 J=9,JJ
      K=K+8
      L=K
      DØ 119 I=5,8
      L=L+1
  119 D(I,J)=-YCØRR(L)
      DØ 120 J=1,JJ
      DØ 120 I=1,JJ
      X1(I,J)=0.0
      DØ 120 M=1,JJ
  120 X1(I,J)=X1(I,J)+C(I,M)*D(M,J)
      DØ 121 J=1,18
      DØ 121 I=1,18
```

```
121 E(I,J)=0.0
    I=1
    E(I,I)=1.0
    E(I+1,I+1)=-SNI
    E(I+2,I+2)=-SNI
    E(I+3,I+3)=1.0
    E(I+1,I+2)=CSI
    E(I+2,I+1)=-CSI
    DØ 122 J=5,JJ
122 E(J,J)=1.0
    DØ 123 J=1,JJ
    DØ 123 I=1,JJ
    X2(I,J)=0.0
    DØ 123 M=1,JJ
123 X2(I,J)=X2(I,J)+X1(I,M)*E(M,J)
    DØ 124 J=1,JJ
    DØ 124 I=1,8
124 B(I,J)=0.0
    J=4
    DØ 125  I=1,4
    J=J+1
125 B(I,J)=1.0
    K=-8
    DØ 126 J=1,4
    K=K+8
    L=K
    DØ 126 I=5,8
    L=L+1
126 B(I,J)=YCØRR(L)
    K = 24
    DØ 127 J=5,8
    K=K+8
    L=K
    DØ 127 I=5,8
    L=L+1
127 B(I,J)=YCØRR(L)
    K=56
    DØ 128 J=9,JJ
    K=K+8
    L=K
    DØ 128 I=5,8
    L=L+1
128 B(I,J)=YCØRR(L)
    DØ 129 J=1,JJ
    DØ 129 I=1,8
    X3(I,J)=0.0
    DØ 129 M=1,JJ
129 X3(I,J)=X3(I,J)+B(I,M)*X2(M,J)
    DØ 130 J=1,8
    DØ 130 I=1,8
130 A(I,J)=0.0
    I=1
    A(I,I)=-1.0
    A(I+1,I+1)=SNI
    A(I+2,I+2)=SNI
    A(I+1,I+2)=CSI
    A(I+2,I+1)=-CSI
    A(I+3,I+3)=1.0
    I=5
    A(I,I)=1.0
    A(I+1,I+1)=-SNJ
```

```
      A(I+2,I+2)=-SNJ
      A(I+3,I+3)=-1.0
      A(I+1,I+2)=-CSJ
      A(I+2,I+1)=CSJ
      DØ 131 J=1,JJ
      DØ 131 I=1,8
      XKT(I,J)=0.0
      DØ 131 M=1,8
  131 XKT(I,J)=XKT(I,J)+A(I,M)*X3(M,J)
      PI=3.1415927
      RI=RTICK
      X2PIRI=2.0*PI*RI
      RJ=RESTØP
      X2PIRJ=2.0*PI*RJ
      DØ 132 J=1,8
      DØ 132 I=1,8
  132 XMAX(I,J)=0.0
      DØ 133 I=1,4
  133 XMAX(I,I)=X2PIRI
      DØ 134 J=5,8
  134 XMAX(J,J)=X2PIRJ
      WRITE (9) ((XKT(I,J),J=1,  8),I=1,4),IGEØM,G1
      WRITE(9) ((XKT(I,J),J=9,JJ),I=1,4)
      DØ 135  J=1,JJ
      DØ 135 I=1,8
      XKS(I,J)=0.0
      DØ 135 M=1,8
  135 XKS(I,J)=XKS(I,J)+XMAX(I,M)*XKT(M,J)
      IF(IPR .EQ. 0)GØ TØ 35
      WRITE (6,781)
  781 FØRMAT(//55X,22HSTIFFNESS CØEFFICIENTS,//14X,8HDELTA T1,7X,8HDELTA
     1 Z1,7X,8HDELTA R1,7X,7HTHETA 1,8X,8HDELTA T2,7X,8HDELTA Z2,7X,8HDE
     2LTA R2,7X,7HTHETA 2)
      III=0
      DØ 20 M=1,8
      II =III+1
      III=II+1
      WRITE(6,23) (LABEL(I),I=II,III), (XKS(M,J),J=1,8)
   23 FØRMAT(/1X,2A4,1X,8(E14.7,1X))
   20 CØNTINUE
 9968 FØRMAT(1H ,8(E14.7,2X)/(5X,8(E14.7,2X)))
   35 J1 = 8
      ISEG=0
      NRC1=NRC-1
      IF(NRC1.EQ.0)GØTØ 143
      DØ 244 I=1,NRC1
  244 ISEG=ISEG+NST(I)
  143 ISEG=ISEG+NSC
      SAVTIC(ISEG)=TIC
      WRITE(2) ((XKS(I,J),J= 1,  8),I= 1,  8)
      DØ 137 J=1,8
      DØ 137 I=1,8
  137 SYM(I,J)=0.0
      INDEC=0
      DØ 138 I=1,8
      DØ 138 J=1,8
      IF(J.NE.I)GØ TØ 138
      IF(XKS(I,J).GE.0.0)GØ TØ 138
      INDEC=1
  138 SYM(I,J)=XKS(I,J)
      IF(INDEC.EQ.0)GØ TØ 151
```

```
      WRITE(6,152)
  152 FØRMAT(////- ***********************************   WARNING - NEGATI
     1VES APPEAR ØN MAIN DIAGØNAL. REVISE SIZING   ****************-//)
  151 JJ=2
      J = 1
      N = 8
      DØ 42  II=1,7
      M = JJ
      DØ 43  I=M,N
      ALPH = ABS(SYM(I,J)) - ABS(SYM(J,I))
      IF(ALPH) 47,71,48
   47 IF (SYM(I,J)) 73,71,73
   73 SYM(I,J) = SYM(J,I)/SYM(I,J)
      GØTØ 43
   48 IF (SYM(J,I)) 74,71,74
   74 SYM(I,J) = SYM(I,J)/SYM(J,I)
      GØTØ 43
   71 SYM(I,J) = 1.0
   43 SYM(J,I) = 0.0
      JJ = JJ +1
      J = J+1
   42 CØNTINUE
      IF(IPR .EQ. 0)GØ TØ 36
      WRITE(6,785)
  785 FØRMAT(//55X,22HSEGMENT SYMMETRY CHECK,)
      DØ 144 I=1,8
  144 WRITE(6,9968)  (SYM(I,J),J=1,8)
   36 DØ 136 J = 1,NPRØB
      J1=J1+1
      DØ 136 I=1,8
  136 XLS(I,J)=XKS( I,J1)
      WRITE(3)((XLS(I,J),J=1,NPRØB),I=1,8)
      IF(IPR .EQ. 0)GØ TØ 9999
      WRITE (6,782)
  782 FØRMAT(//55X,22HSEGMENT LØAD MATRICES ,)
      DØ 840 I=1,8
  840 WRITE(6,9968)(XLS(I,J),J=1,NPRØB)
      WRITE(6,795) RTICK,RESTØP
  795 FØRMAT(////- RZERØ(I) =-,1PE15.6,10X,-RZERØ(J) =-,1PE15.6)
      GØTØ 9999
 8120 IERRØR=8120
      NERRØR=29
      NIX = 1
 9999 RETURN
      END
```

```
FØR,IS SREVN2,SREVN2
      SUBRØUTINE SREVN2(A,M,LØC,MID,NIX)
      DØUBLE PRECISIØN A(MID,1),PIVØT,TEMP1
      INTEGER LØC(1)
  100 N = M
      DØ 190  K = 1,N
      PIVØT = 0.D0
      DØ 120  I = K,N
      IF (PIVØT - DABS(A(I,K))) 110,110,120
  110 PIVØT = DABS(A(I,K))
      L = I
  120 CØNTINUE
      IF (PIVØT) 140,130,140
  130 NIX = -1
      GØ TØ 210
  140 LØC(K) = L
      DØ 150  J = 1,N
      TEMP1 = A(K,J)
      A(K,J) = A(L,J)
  150 A(L,J) = TEMP1
      TEMP1 = A(K,K)
      A(K,K) = 1.D0
      DØ 160  J = 1,N
  160 A(K,J) = A(K,J)/TEMP1
      DØ 190  I = 1,N
      IF (I - K) 170,190,170
  170 TEMP1 = -A(I,K)
      A(I,K) = 0.D0
      DØ 180   J = 1,N
  180 A(I,J) = A(I,J) + TEMP1*A(K,J)
  190 CØNTINUE
      DØ 200  K = 1,N
      NK = N - K
      L = LØC(NK+1)
      DØ 200  I = 1,N
      TEMP1 = A(I,NK+1)
      A(I,NK+1) = A(I,L)
  200 A(I,L) = TEMP1
      NIX = 0
  210 RETURN
      END
```

SUBROUTINE REGMAT

The segment stiffness matrices, XKS, and the segment load matrices, XLS, are passed from SEGMAT to REGMAT via Tapes #2 and #3, and are placed in the XKRTOT array and the XLRTOT array, respectively. If kinematic links occur between segments in the region, the XKRTOT array and the XLRTOT array are modified to represent the situation. In the case of discrete rings the routine RINGER is called and provides the necessary matrices.

A horizontal and vertical partitioning of the XKRTOT array occurs while the XLRTOT array is subjected to a horizontal partitioning only. Appropriate matrix operations are performed upon the partitions of each array, thus reducing the size of the region stiffness and load matrices and resulting in increased program capacity. The results of these manipulations are the region stiffness matrix, XKR, and the region load matrix, XLR.

Subroutines Called from REGMAT

Subroutine SWITCH: Is a routine used to arrange a matrix in a form convenient for use by another routine employing a positive definite method for solving linear algebraic equations.

Subroutine CHASE: Is a routine used to obtain the solution X of the linear system AX = Y, given at least one right side of Y and the positive, definite, symmetric, real coefficient matrix A.

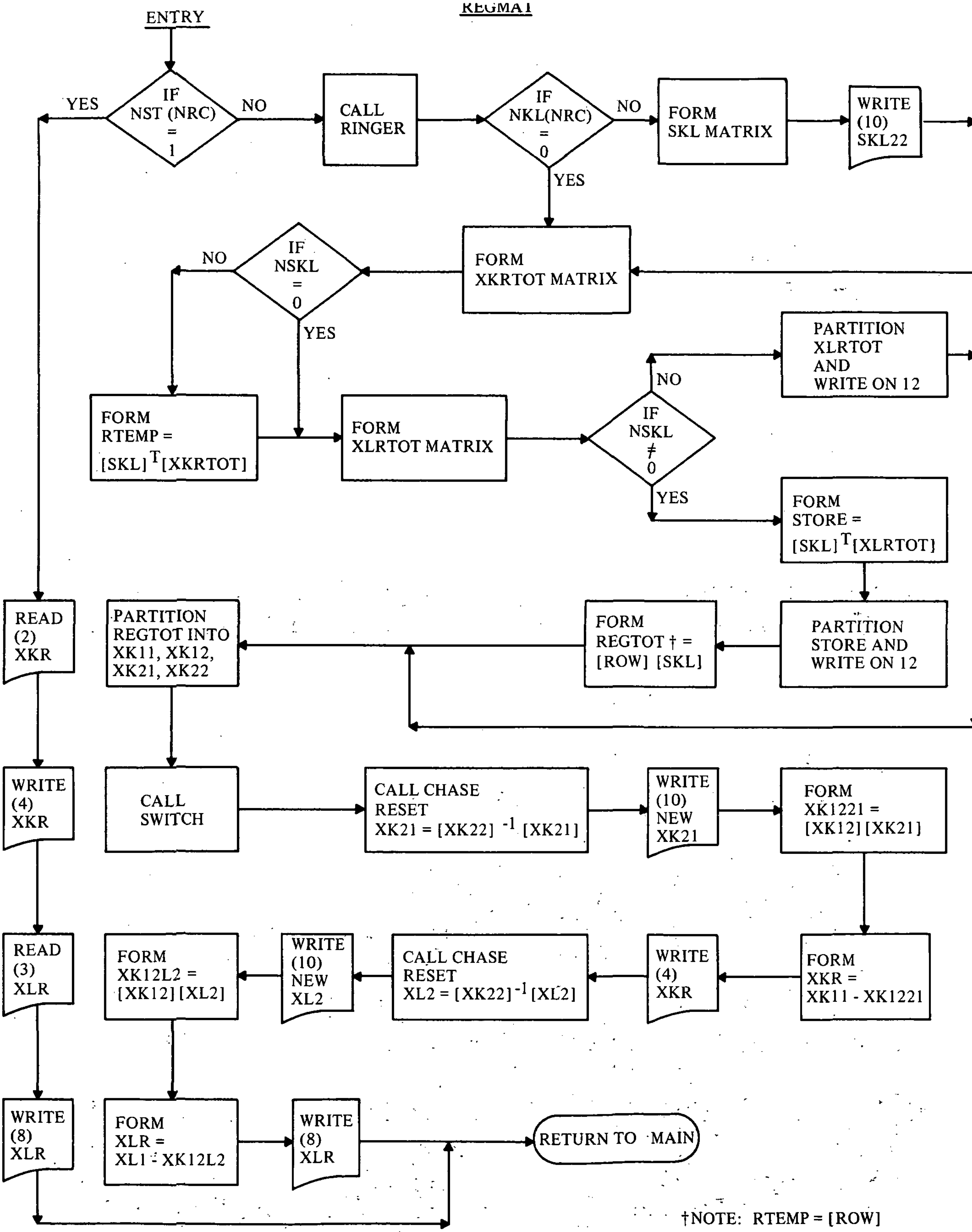
Subroutine FUTILE: Is a routine called from CHASE and used to obtain the factorization of the positive definite, real, symmetric matrix A into the product of a lower triangular matrix and its transpose by utilizing a Cholesky decomposition.

Subroutine TRIEQ: Is a routine called by CHASE to solve a triangular system of algebraic equations.

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
SKL MATRIX	$\left[SKL \right]$
SKLTR MATRIX	$\left[SKL \right]^T$
XKRTOT MATRIX	$\widehat{\left[\begin{array}{c:c} K'_{11} & K'_{12} \\ \hdashline K'_{21} & K'_{22} \end{array} \right]}$
XLRTOT MATRIX	$\widehat{\left[\begin{array}{c} L'_{iR1} \\ L'_{jR1} \\ \hdashline L' \end{array} \right]}$
SKL22 MATRIX	$\left[SKL_{22} \right]$
REGTOT MATRIX	$\widehat{\left[\begin{array}{c:c} K_{11} & K_{12} \\ \hdashline K_{21} & K_{22} \end{array} \right]}$
STORE MATRIX	$\widehat{\left[\begin{array}{c} L_{iR1} \\ L_{jR1} \\ \hdashline L \end{array} \right]}$
XK11 PARTITION	$\widehat{\left[K_{11} \right]}$
XK12 PARTITION	$\widehat{\left[K_{12} \right]}$
XK22 PARTITION	$\widehat{\left[K_{22} \right]}$
XK21 PARTITION	$\widehat{\left[K_{21} \right]}$

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
XL1 PARTITION	$\left[\hat{L}_{R1}\right]$
XL2 PARTITION	$\left[\hat{L}\right]$
XKR MATRIX	$\left[\hat{K}_{R}\right]$
XLR MATRIX	$\left[\hat{L}_{R}\right]$

REGMAT



†NOTE: RTEMP = [ROW]

```
FØR,IS REGMAT,REGMAT
      SUBRØUTINE REGMAT
      INTEGER SAVJTC,SAVSTP,Q,THICK
      CØMMØN STØRY(16),TALE(16),XMAT(110,10),STD(10),SADUS(30),RADUS(30)
      CØMMØN TADUS(30),UADUS(30),SAVTIC(900)
      CØMMØN XN,TEFREE,TIC,PHI,STØP,RESTØP,RTICK,G1,XNL
      CØMMØN NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)
      CØMMØN JRSTØP(30),NREG,NSEGTL,NMPT,MATPRP,NCUPLE,NRGEND,NSYM,NRG
      CØMMØN NRC,NSC,NIX,IERRØR,IØUT,MAT,KGEØM,IGEØM,ITYPE,ISTTAB,KELVIN
      CØMMØN IBEGIN,NPRØB,NHARM,NSEG,NERRØR, Q ,NSMAX,THICK
      CØMMØN /ØPT2/ PRINT
      CØMMØN/HARMØN/ NHRC,IRCNT, HARM(25), HARPØS(25),
     1IHCLUE(2),THEANG(36),NANG,LUNSUM,LUN1,ISWICH,NUMØUT
     2,NHAR
      CØMMØN /ARING/ NRING(28)
      INTEGER HARPØS
      DIMENSIØN ØPEN(4,4)
      DIMENSIØN XTEMP(8,8),SKL(100,100),SKLTR(100)
      DIMENSIØN SYM(8,8)
      DIMENSIØN XKRTØT(100,100),RTEMP(100),XLRTØT(100,10),XKEEP(8,10)
      DIMENSIØN STØRE(100,10),RØW(100),REGTØT(100),HØLD(4,100)
      DIMENSIØN XK22(100,100),XK11(8,8),XK12(8,100),XK21(100,8)
      DIMENSIØN XKIV(5050),XK1221(8,8),XKR(8,8)
      DIMENSIØN XL1(8,10),XL2(100,10),XK12L2(8,10),XLR(8,10)
      DIMENSIØN JDEP(15),JIND(15),ANGLE(15)
      DIMENSIØN RNGTØT(4,4),RNGLØD(4,28),JTNØ(28)
      DIMENSIØN LABEL(16)
      DIMENSIØN     N1(2)     ,N2(2)     ,N3(2)     ,N4(2)
      DIMENSIØN     N5(2)     ,N6(2)     ,N7(2)     ,N8(2)
      EQUIVALENCE (SYM(1),XK12L2(1),XK1221(1),HØLD(1),JDEP(1))
      EQUIVALENCE (LABEL( 1),N1(1)),(LABEL( 3),N2(1))
      EQUIVALENCE (LABEL( 5),N3(1)),(LABEL( 7),N4(1))
      EQUIVALENCE (LABEL( 9),N5(1)),(LABEL(11),N6(1))
      EQUIVALENCE (LABEL(13),N7(1)),(LABEL(15),N8(1))
      EQUIVALENCE (SKL(1),XKRTØT(1),XK22(1),XKIV(1),XLRTØT(1))
      EQUIVALENCE (XKR(1),XK11(1),XTEMP(1),XLR(1),XL1(1),XKEEP(1),
     1            RTEMP(1),RØW(1))
      EQUIVALENCE (SKLTR(1),REGTØT(1),ØPEN(1),XK12(1))
      EQUIVALENCE (STØRE(1),XL2(1),XK21(1))
      DATA N1                 /8HFØRCE T1/
      DATA N2                 /8HFØRCE Z1/
      DATA N3                 /8HFØRCE R1/
      DATA N4                 /8HMØMENT 1/
      DATA N5                 /8HFØRCE T2/
      DATA N6                 /8HFØRCE Z2/
      DATA N7                 /8HFØRCE R2/
      DATA N8                 /8HMØMENT 2/
      REWIND 2
      REWIND 3
      REWIND 12
      D = 0.0
      PRINT = 0.0
      NØJ = NST(NRC) + NKL(NRC) +1
      NØJ4 = NØJ*4
      NSKL = NKL(NRC)
      NH4=4
      NJTNH4=NH4*NØJ
      NJINK4 = (NØJ-NSKL)*4
      M8=NJINK4-8
      NKIV = NJINK4 - 8
      IF (NST(NRC).EQ.1) GØTØ 1
```

```
      IPR = 1                                                           900630
      IF(Q.EQ. 1 .AND. IHCLUE(2) .EQ. 1)IPR =0                          900640
      IF(IPR.EQ. 0)GØ TØ 562                                            900650
      WRITE(6,1726)                                                     900660
 1726 FØRMAT(1H1)                                                       900670
      WRITE(6,681) NRC,NØJ,NSKL                                         900680
  681 FØRMAT(////51X31HINPUT DATA FØR SEGMENT CØUPLING///25X14HREGIØN NU 900690
     1MBER ,I2,5X25HNUMBER ØF SEGMENT JØINTS ,I3,5X,26HNUMBER ØF KINEMAT 900700
     2IC LINKS ,I3//)                                                   900710
      WRITE(6,682)                                                      900720
  682 FØRMAT(41X,7HSEGMENT,11X,8HJØINT(I),11X,8HJØINT(J)//)             900670
  562 DØ 683 I = 1,NSEG                                                 900750
      KTIC = SAVJTC(I)                                                  900760
      KSTØP= SAVSTP(I)                                                  900770
      IF(IPR .EQ. 0)GØ TØ 683                                           900780
      WRITE(6,684) I,KTIC,KSTØP                                         900720
  684 FØRMAT(43X,2(I3,16X),I3)                                          900730
  683 CØNTINUE                                                          900810
      NNT = NST(NRC)                                                    900820
      DØ 350 I=1,NØJ4
      DØ 350 J=1,NØJ4
  350 XKRTØT(I,J)=0.0                                                   900850
  591 FØRMAT (3I5,16A4)                                                 900860
      DØ 701 NS=1,NNT                                                   900870
      READ(2) ((XTEMP(I,J),J=1,8),I=1,8)                                900880
      J1 = SAVJTC(NS)                                                   900890
      J2 = SAVSTP(NS)                                                   900900
      II = 4*(J1-1)                                                     900910
       L = II                                                           900920
      IF (J1.GT.J2) GØTØ 950                                            900930
      DØ 910  I = 1,8                                                   900940
       JJ = L                                                           900950
      II = II + 1                                                       900960
      DØ 910  J = 1,8                                                   900970
      JJ = JJ + 1                                                       900980
  910 XKRTØT(II,JJ)=XKRTØT(II,JJ)+XTEMP(I,J)                            900990
      GØTØ 701                                                          901000
  950 JJ = 4*(J2-1)+1                                                   901010
      II = II + 1                                                       901020
      DØ 960  JK = 1,4                                                  901030
      GØTØ (951,952,953,954) , JK                                       901040
  951 IX = II                                                           901050
      IND = II                                                          901060
      DØ 961 I=1,4                                                      901070
      DØ 961 J=1,4                                                      901080
  961 ØPEN(I,J) = XTEMP(I,J)                                            901090
      GØTØ 955                                                          901100
  952 IX = II                                                           901110
      IND = JJ                                                          901120
      DØ 962 I=1,4                                                      901130
      DØ 962 J=1,4                                                      901140
  962 ØPEN(I,J) = XTEMP(I,J+4)                                          901150
      GØTØ 955                                                          901160
  953 IX = JJ                                                           901170
      IND = II                                                          901180
      DØ 963 I=1,4                                                      901190
      DØ 963 J=1,4                                                      901200
  963 ØPEN(I,J) = XTEMP(I+4,J)                                          901210
      GØTØ 955                                                          901220
  954 IX = JJ                                                           901230
      IND = JJ                                                          901240
```

```
      DØ 964 I=1,4
      DØ 964 J=1,4
  964 ØPEN(I,J) = XTEMP(I+4,J+4)
  955 DØ 956 I=1,4
      JX = IND
      DØ 957 J=1,4
      XKRTØT(IX,JX) = XKRTØT(IX,JX) + ØPEN(I,J)
  957 JX = JX + 1
  956 IX = IX + 1
  960 CØNTINUE
  701 CØNTINUE
      NRNG = NRING(NRC)
      IF (NRING(NRC).EQ.0) GØ TØ 210
      IF (Q.EQ.5) WRITE(6,300)
  300 FØRMAT(///)
      DØ 211 J=1,NRNG
      CALL RINGER (Q,XN,RNGTØT,RNGLØD,J,RADUS,TADUS,SAVJTC,SAVSTP,JTNØ,
     1             NSEG)
      JT = 4*(JTNØ(J)-1)
      DØ 220 I=1,4
      DØ 220 IK=1,4
  220 XKRTØT(JT+I,JT+IK) = XKRTØT(JT+I,JT+IK)+RNGTØT(I,IK)
  211 CØNTINUE
      IF (Q.NE.5) GØ TØ 210
      WRITE(6,300)
      READ(5,2000)
 2000 FØRMAT(1X)
  210 CØNTINUE
      REWIND   2
      IF(NSKL.NE.0) GØ TØ 931
      DØ 5504 I=1,NØJ4
      WRITE(2) (XKRTØT(I,J),J=1,NØJ4)
 5504 CØNTINUE
      GØ TØ 101
  931 CØNTINUE
      WRITE(12) ((XKRTØT(I,J),J=1,NØJ4),I=1,NØJ4)
      REWIND 12
      DØ 501 J=1,NJTNH4
      DØ 501 I=1,NJTNH4
  501 SKL(I,J)=0.0
      IF(IPR .EQ. 0)GØ TØ 564
      WRITE(6,685)
  685 FØRMAT(//60X13HSEGMENT LINKS//43X8HJØINT(J)5X8HJØINT(I)5X20HANGLE
     1ØF ØRIENTATIØN//)
  564 DØ 103 NRIG = 1,NSKL
      IF(Q.EQ.1)GØ TØ 566
      READ (5,503) JDEP(NRIG),JIND(NRIG),ANGLE(NRIG),(TALE(I),I=1,15)
  503 FØRMAT (2I2,E14.7,15A4)
      WRITE(1)JDEP(NRIG),JIND(NRIG),ANGLE(NRIG)
      GØ TØ 567
  566 READ(1)JDEP(NRIG),JIND(NRIG),ANGLE(NRIG)
  567 IF(IPR .EQ. 0)GØ TØ 834
      WRITE(6,686) JDEP(NRIG),JIND(NRIG),ANGLE(NRIG)
  686 FØRMAT(45X,I3,10X,I3,11X,E14.7)
  834 CØNTINUE
      IF(JIND(NRIG).GE.JDEP(NRIG)) GØ TØ 8797
  103 CØNTINUE
      IF (Q.EQ.5) READ(5,2000)
      J = -3
      N = 1
      DØ 100  IJ = 1,NØJ
```

```
      I = 4*IJ-3
      IF((J.EQ.JDEP(N)) GØTØ 11
      J = J + 4
      GØTØ 12
   11 JD = JDEP(N)
      JI = JIND(N)
      CØTAN = CØS(ANGLE(N))/SIN(ANGLE(N))
      IF(N.LT.NRIG) N=N+1
      SKL(  I,   J) = RADUS(JD)/RADUS(JI)
      SKL(I+1,J+3) =-(RADUS(JD)-RADUS(JI))
      SKL(I+2,J+3) =-SKL(I+1,J+3)*CØTAN
      GØTØ 13
   12 SKL(  I,   J) = 1.0
   13 SKL(I+1,J+1) = 1.0
      SKL(I+2,J+2) = 1.0
      SKL(I+3,J+3) = 1.0
  100 CØNTINUE
 5000 FØRMAT(1H ,8(E14.7,2X)/(5X,8(E14.7,2X)))
      II = NØJ4 - 4
      JJ = NJINK4 - 4
      DØ 768 I=5,II
  768 WRITE(10) (SKL(I,J),J=5,JJ)
      DØ 702 J=1,NJINK4
  702 WRITE(2)  (SKL(I,J),I=1,NØJ4)
      WRITE(2) ((SKL(I,J),J=1,NJINK4),I=1,NØJ4)
      REWIND 2
      READ(12) ((XKRTØT(I,J),J=1,NØJ4),I=1,NØJ4)
      REWIND 12
      DØ 740 I=1,NJINK4
      READ(2) (SKLTR(J),J=1,NØJ4)
      DØ 741 J=1,NØJ4
      RTEMP  (J)=0.0
      DØ 741 K=1,NØJ4
  741 RTEMP  (J)=RTEMP  (J)+SKLTR(K)*XKRTØT(K,J)
      WRITE(12) (RTEMP  (J),J=1,NØJ4)
  740 CØNTINUE
      REWIND 2
      REWIND 12
  101 DØ 436 I = 1,NØJ4
      DØ 436 J=1,NPRØB
  436 XLRTØT(I,J)=0.0
      DØ  971 NS = 1,NNT
      JTIC = SAVJTC(NS)
      JSTØP= SAVSTP(NS)
      READ (3) ((XKEEP(I,J),J=1,NPRØB),I=1,8)
      DØ  971 N =1,2
      GØTØ (981,982),N
  981 II = (JTIC-1)*4 + 1
      III= II + 3
      GØTØ 983
  982 II = (JSTØP-1)*4 +1
      III= II + 3
  983 DØ  971 J=1,NPRØB
      I =0
      IF (N.EQ.2) I=4
      DØ  971 IL = II,III
      I = I + 1
  971 XLRTØT(IL,J)= XLRTØT(IL,J)+ XKEEP(I,J)
      IF (NRNG.EQ.0) GØ TØ 230
      DØ 225 J=1,NRNG
      JT = 4*(JTNØ(J)-1)
```

```
      DØ 226 I=1,4
      DØ 226 IK=1,NPRØB
  226 XLRTØT(JT+I,IK) = XLRTØT(JT+I,IK)+RNGLØD(I,J)
  225 CØNTINUE
  230 CØNTINUE
      REWIND 3
      IF (NSKL.NE.0) GØTØ 147
      DØ 119 I=1,4
  119 WRITE(3) (XLRTØT(I,J),J=1,NPRØB)
      M3=NJINK4-3
      DØ 118 I=M3,NJINK4
  118 WRITE(3) (XLRTØT(I,J),J=1,NPRØB)
      M4=NJINK4-4
      DØ 117 I=5,M4
  117 WRITE(3) (XLRTØT(I,J),J=1,NPRØB)
      REWIND 3
      GØTØ 102
  147 DØ 747  I=1,NJINK4
      READ(2) (SKLTR(J),J=1,NØJ4)
      DØ 748  J=1,NPRØB
      STØRE(I,J)=0.0
      DØ 748   K=1,NØJ4
  748 STØRE(I,J)=STØRE(I,J)+SKLTR(K)*XLRTØT(K,J)
  747 CØNTINUE
      DØ 919 I=1,4
  919 WRITE(3) (STØRE(I,J),J=1,NPRØB)
      M3=NJINK4-3
      DØ 918 I=M3,NJINK4
  918 WRITE(3) (STØRE(I,J),J=1,NPRØB)
      M4=NJINK4-4
      DØ 917 I=5,M4
  917 WRITE(3) (STØRE(I,J),J=1,NPRØB)
      REWIND 3
      READ(2) ((SKL(I,J),J=1,NJINK4),I=1,NØJ4)
      REWIND 2
      DØ 750 I=1,NJINK4
      READ(12) (RØW(J),J=1,NØJ4)
      DØ 751 J=1,NJINK4
      REGTØT  (J)=0.0
      DØ 751 K=1,NØJ4
  751 REGTØT  (J)=REGTØT  (J)  +  RØW(K)*SKL(K,J)
  750 WRITE(2) (REGTØT(J),J=1,NJINK4)
C     THE 780 LØØP REARRANGES AND PARTITIØNS THE REGIØN STIFFNESS MATRIX
  102 NJINK = NJINK4/4
      REWIND 2
      DØ 625 INK=1,8
      DØ 626 JAK=1,8
  626 XK11(INK,JAK)=0.0
      DØ 625 KIX=1,M8
      XK12(INK,KIX)=0.0
      XK21(KIX,INK)=0.0
  625 CØNTINUE
      DØ 627 KIX=1,M8
      DØ 627 LAX=1,M8
  627 XK22(KIX,LAX)=0.0
      NREAD=0
      KØUNT=-8
      NJINK3=NJINK-1
      DØ 780 N=1,NJINK
      NREAD=NREAD+1
      KØUNT=KØUNT+4
```

```
      DØ 781 I=1,4
  781 READ(2)  (HØLD(I,J),J=1,NJINK4)
      IF(NREAD.LE.2.ØR.NREAD.GE.NJINK3)GØ TØ 790
      KK=KØUNT+1
      KKK=KØUNT+12
      DØ 785 L=KK,KKK
      IRØW=4*(NREAD-2)
      J=L-4
      DØ 785 K=1,4
      IRØW=IRØW+1
  785 XK22(IRØW,J)=HØLD(K,L)
      GØ TØ 780
  790 IF(NREAD.EQ.1)GØ TØ 791
      IF(NREAD.EQ.2)GØ TØ 792
      IF(NREAD.EQ.NJINK3)GØ TØ 793
      IF(NREAD.EQ.NJINK)GØ TØ 794
  791 DØ 796 I=1,4
      DØ 796 J=1,4
      XK11(I,J)=HØLD(I,J)
      JJ=J+4
  796 XK12(I,J)=HØLD(I,JJ)
      GØ TØ 780
  792 DØ 797 I=1,4
      DØ 797 J=1,4
      XK21(I,J)=HØLD(I,J)
      JJ=J+4
      XK22(I,J)=HØLD(I,JJ)
      JJJ=J+8
      IF(NNT.EQ.2)  GØ TØ 795
      XK22(I,JJ)=HØLD(I,JJJ)
       GØ TØ 797
  795 XK21(I,JJ)=HØLD(I,JJJ)
  797 CØNTINUE
      GØ TØ 780
  793 M11=NJINK4-11
      M4=NJINK4-4
      M8=NJINK4-8
      KRØW=M8-4
      DØ 798 I=1,4
      KRØW=KRØW+1
      KCØL=4
      K8=M8-8
      DØ 798 J=M11,M8
      K8=K8+1
      XK22(KRØW,K8)=HØLD(I,J)
      JJ=J+4
      KK=K8+4
      XK22(KRØW,KK)  =HØLD(I,JJ)
      JJJ=J+8
      KCØL=KCØL+1
  798 XK21(KRØW,KCØL)=HØLD(I,JJJ)
      GØ TØ 780
  794 KEND=NJINK4-8
      KRØW=4
      M4=NJINK4-4
      M7=NJINK4-7
      DØ 799 I=1,4
      KRØW=KRØW+1
      K4=KEND-4
      KCØL=4
      DØ 799 J=M7,M4
```

```
      K4=K4+1                                                           903680
      XK12(KRØW,K4)=HØLD(I,J)                                           903690
      KCØL=KCØL+1                                                       903700
      JJ=J+4                                                            903710
  799 XK11(KRØW,KCØL)=HØLD(I,JJ)                                        903720
  780 CØNTINUE                                                          903730
 7703 CØNTINUE
      N=NKIV                                                            903750
      IK=1                                                              903760
      DØ 10 K=1,N                                                       903780
      DØ 10 I=K,N                                                       903790
      XK22(I,K)=(XK22(I,K)+ XK22(K,I))/2.                               903800
      XKIV(IK)=XK22(I,K)                                                903810
   10 IK=IK+1                                                           903820
      CALL SWITCH (XKIV,-NKIV)                                          903830
      CALL CHASE (XKIV,NKIV,XK21,8,100,NIX)
      IF (NIX.LT.0) GØTØ 8841                                           903850
      WRITE (10) ((XK21(I,J),J=1,8),I=1,M8   )                          903900
      WRITE (10)(( SAVJTC(I), SAVSTP(I)),I=1,NNT)                       903910
      DØ 81 J=1,8                                                       903920
      DØ 81 I=1,8                                                       903930
      XK1221(I,J)=0.0                                                   903940
      DØ 81 K=1,NKIV                                                    903950
   81 XK1221(I,J)=XK1221(I,J)+XK12(I,K)*XK21(K,J)                       903960
      DØ 82 J=1,8                                                       903970
      DØ 82 I=1,8                                                       903980
   82 XKR(I,J)=XK11(I,J)-XK1221(I,J)                                    903990
      WRITE (4) ((XKR(I,J),J=1,8),I=1,8)                                904000
      IF(IPR.EQ.0)GØ TØ 568                                             904020
      WRITE(6,5011)                                                     904030
 5011 FØRMAT(////55X23HREGIØN STIFFNESS MATRIX//14X8HDELTA T17X8HDELTA Z 904040
     11,7X,8HDELTA R1,7X,7HTHETA 1,8X,8HDELTA T2,7X,8HDELTA Z2,7X,8HDELT 904050
     2A R2,7X,7HTHETA 2)                                                904060
      III=0                                                             904070
      DØ 687 M=1,8                                                      904080
      II=III+1                                                          904090
      III=II+1                                                          904100
      WRITE(6,688)  (LABEL(I),I=II,III),(XKR(M,J),J=1,8)                904110
  688 FØRMAT(/1X,2A4,1X,8(E14.7,1X))                                    904120
  687 CØNTINUE                                                          904130
  568 DØ 137 J = 1,8                                                    904140
      DØ 137 I=1,8                                                      904150
  137 SYM(I,J)=0.0                                                      904160
      INDEC=0                                                           904170
      DØ 138 I=1,8                                                      904180
      DØ 138 J=1,8                                                      904190
      IF(J.NE.I)GØ TØ 138                                               904200
      IF(XKR(I,J).GE.0.0)GØ TØ 138                                      904210
      INDEC=1                                                           904220
  138 SYM(I,J)=XKR(I,J)                                                 904230
      IF(INDEC.EQ.0)GØ TØ 151                                           904240
      WRITE(6,152)                                                      904250
  152 FØRMAT(////- ************************************   WARNING - NEGATI 904260
     1VES APPEAR ØN MAIN DIAGØNAL. REVISE SIZING   *****************-//) 904270
  151 JJ=2                                                              904280
      N  =8                                                             904290
      J  = 1                                                            904300
      DØ 42  II=1,7                                                     904310
      M  = JJ                                                           904320
      DØ 43  I=M,N                                                      904330
      ALPH = ABS(SYM(I,J)) - ABS(SYM(J,I))                              904340
```

```
      IF(ALPH) 47,71,48                                                 904350
   47 IF (SYM(I,J)) 73,71,73
   73 SYM(I,J) = SYM(J,I)/SYM(I,J)
      GØTØ 43                                                           904380
   48 IF (SYM(J,I)) 74,71,74
   74 SYM(I,J) = SYM(I,J)/SYM(J,I)
      GØTØ 43                                                           904410
   71 SYM(I,J) = 1.0                                                    904420
   43 SYM(J,I) = 0.0                                                    904430
      JJ = JJ +1                                                        904440
      J = J+1                                                           904450
   42 CØNTINUE                                                          904460
      IF(IPR.EQ. 0)GØ TØ 569                                            904470
      WRITE(6,157)                                                      904480
  157 FØRMAT(//56X,21HREGIØN SYMMETRY CHECK/)                           904490
      DØ 1730 I=1,8                                                     904500
      WRITE(6,5000) (SYM(I,J),J=1,8)                                    904510
 1730 CØNTINUE                                                          904520
  569 DØ 819 I = 1,4                                                    904530
  819 READ(3)  (XL1(I,J),J=1,NPRØB)                                     904540
      DØ 818 I=5,8                                                      904550
  818 READ(3)  (XL1(I,J),J=1,NPRØB)                                     904560
      D = 0.0                                                           904570
      M8 = NJINK4-8                                                     904580
      DØ 817 I=1,M8                                                     904590
  817 READ(3)  (XL2(I,J),J=1,NPRØB)                                     904600
      CALL CHASE (XKIV,NKIV,XL2,-NPRØB,100,NIX)
      IF (NIX.LT.0) GØTØ 8842                                           904630
      WRITE (10) ((XL2(I,J),J=1,NPRØB),I=1,M8    )                      904680
      NL2=NPRØB                                                         904690
      DØ 205  J=1,NPRØB                                                 904700
      DØ 205  I=1,8                                                     904710
      XK12L2(I,J)=0.0                                                   904720
      DØ 205  K=1,NKIV                                                  904730
  205 XK12L2(I,J)=XK12L2(I,J)+XK12(I,K)*XL2(K,J)                        904740
      DØ 206  J=1,NPRØB                                                 904750
      DØ 206  I=1,8                                                     904760
  206 XLR(I,J)=XL1(I,J)-XK12L2(I,J)                                     904770
      WRITE(8) ((XLR(I,J),J=1,NPRØB),I=1,8)                             904780
      IF(IPR.EQ.0)GØ TØ 150                                             904790
      WRITE(6,5012)                                                     904800
 5012 FØRMAT(//57X,18HREGIØN LØAD MATRIX/)                              904810
      DØ 5512 I=1,8                                                     904820
 5512 WRITE(6,5000)  (XLR(I,J),J=1,NPRØB)                               904830
      GØTØ 150                                                          904840
 8841 IERRØR=8841                                                       904850
      NERRØR=30                                                         904860
      GØTØ 150                                                          904870
 8797 IERRØR = 8797                                                     904880
      NERRØR=33                                                         904890
      GØ TØ 150                                                         904900
 8842 IERRØR=8842                                                       904910
      NERRØR=31                                                         904920
      GØTØ 150                                                          904930
    1 READ (2) ((XKR(I,J),J=1,8),I=1,8)                                 904940
      WRITE(4) ((XKR(I,J),J=1,8),I=1,8)                                 904950
      READ(3)  ((XLR(I,J),J=1,NPRØB),I=1,8)                             904960
      WRITE(8) ((XLR(I,J),J=1,NPRØB),I=1,8)                             904970
  150 RETURN                                                            904980
       END                                                              904990
```

```
FØR,IS SWITCH,SWITCH
      SUBRØUTINE SWITCH(A,M)
      DIMENSIØN A(1)
      N = IABS(M)
      IF (N - 2) 190,190,90
   90 L = (N*(N+1)) / 2
      KEY = 1
      LØCK = N/2 + 1
      IF (M) 100,190,160
  100 IF (N - 3) 110,140,110
  110 KKT = 3
      NKF = N - 1
      IMAGE = L
      INTØ = L - 3
      I = 3
      DØ 130  K = 2,LØCK
      DØ 120  IK = KKT,NKF
      X = A(IK)
      A(IK) = A(INTØ)
      A(INTØ) = X
      INTØ = INTØ - 1
  120 I = I + 1
      KKT = NKF + K
      NKF = NKF + N - K
      IMAGE = IMAGE - K
      INTØ = IMAGE
  130 I = K
  140 IF (KEY) 150,190,150
  150 KEY = 0
  160 LØV2 = L / 2
      K = L - 2
      DØ 170  I = 3,LØV2
      X = A(I)
      A(I) = A(K)
      A(K) = X
  170 K = K - 1
      IF (KEY) 180,190,180
  180 KEY = 0
      GØ TØ 100
  190 RETURN
       END
```

```
FØR,IS CHASE,CHASE
      SUBRØUTINE CHASE(A,MO,Y,NO,MID,NIX)
      REAL A(1),Y(1)
      CØMMØN /WINTER/ INDIC8
      CØMMØN /BØND/ M,L
      CØMMØN /ØPT2/ PRINT
    9 FØRMAT(12H1SØLUTIØN(S)/1H0)
   10 FØRMAT (I5,1P8E15.7/(5X,8E15.7))
      M = MO
      INDIC8 = 0
      N = IABS(NO)
      IF (NO) 110,100,100
  100 CALL FUTILE(A,M,NIX)
      IF (NIX) 170,110,110
  110 PRINT = 0.0
      IF (PRINT .GT. 0.0)  WRITE(6,9)
      MK1 = 1
      L = 1
      I1 = M
      DØ 160  K = 1,N
      CALL TRIEQ(A,Y(MK1))
      IF (PRINT .GT. 0.) WRITE (6,10) K,(Y(K1), K1 = MK1,I1)
      I1 = I1 + MID
      MK1 = MK1 + MID
  160 CØNTINUE
  170 RETURN
      END
```

```
FØR,IS FUTILE,FUTILE
      SUBRØUTINE FUTILE(A,N,NIX)
      DIMENSIØN A(1)
      DØUBLE PRECISIØN SUM
      EQUIVALENCE (SUN,SUM)
      K1 = 1
      KK = 0
      DØ 210  K = 1,N
      KK = KK + K
      IK = KK
      KK1 = KK - 1
      IF (KK1) 60,50,60
   50 ASSIGN 100 TØ LEAP
      GØ TØ 70
   60 ASSIGN  80 TØ LEAP
   70 I1 = K1
      DØ 140  I = K,N
      SUM = -A(IK)
      GØ TØ LEAP, (80,100)
   80 IJ = I1
      DØ 90 KJ = K1,KK1
      SUM = SUM + A(IJ)*A(KJ)
   90 IJ = IJ + 1
  100 I1 = I1 + I
      IF (I - K) 120,105,120
  105 DENØM = -SUM
      IF (DENØM) 980,980,110
  110 DENØM = -SQRT(DENØM)
      A(IK) = -DENØM
      GØ TØ 130
  120 A(IK) = SUM / DENØM
  130 IK = IK + I
  140 CØNTINUE
      K1 = K1 + K
  210 CØNTINUE
      NIX = 0
  220 RETURN
  980 NIX = -K
      GØ TØ 220
       END
```

```
FØR,IS TRIEQ,TRIEQ
      SUBRØUTINE TRIEQ(A,Y)
      REAL A(1),Y(1)
      CØMMØN /WINTER/INDIC8
      CØMMØN /BØND/ M,L
      DØUBLE PRECISIØN SUM
      EQUIVALENCE (SUN,SUM)
      L1 = L
      LM1 = L1 - 1
      MM1=M-1
      IF(INDIC8) 130,100,100
  100 Y(L1) = Y(L1) / A(L1)
      IF (MM1) 105,125,105
  105 I1 = L1
      DØ 120  I = L1,MM1
      I1 = I1 + I
      SUM = -Y(I+1)
      IJ = I1
      DØ 110  J = L1,I
      SUM = SUM + A(IJ)*Y(J)
  110 IJ = IJ + 1
      II = IJ
  120 Y(I+1) = -SUM / A(II)
  125 IF (INDIC8) 170,140,170
  130 II = (M*M + M) / 2  -  LM1
  140 I = M
  145 Y(I) = Y(I) / A(II)
      II = II - I
      I = I - 1
      IF (I - L1) 170,150,150
  150 SUN = -Y(I+1)
      IJ = II + L1
      DØ 160  J = L1,I
      Y(J) = Y(J) + SUN*A(IJ)
  160 IJ = IJ + 1
      GØ TØ 145
  170 RETURN
       END
```

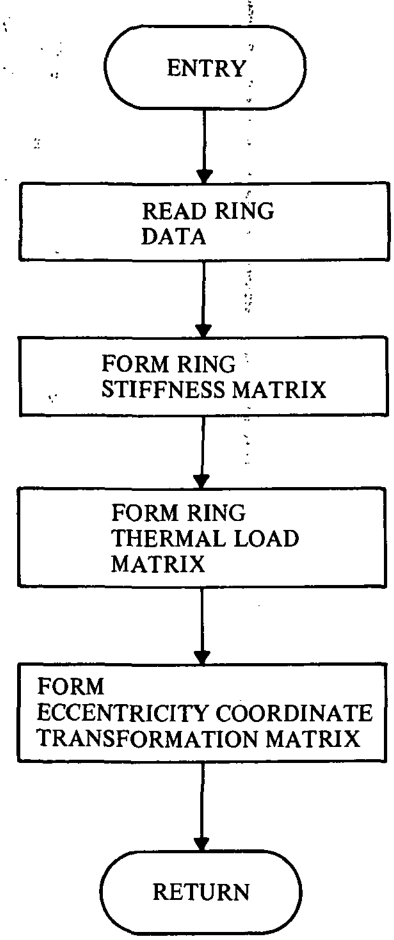
SUBROUTINE RINGER

This subroutine reads the discrete ring geometric data, and temperatures, and forms the ring stiffness and thermal load matrices. These matrices are passed back to either of subroutines REGMAT or STRMAT (see next) as necessary, for incorporation into the region or structure matrices, respectively.

The calculations in RINGER account for the eccentricity of the ring centroid from the base shell wall, and the offset of the ring centroid from the shear center.

FORTRAN CODE	ENGINEERING SYMOBLS (REF. 1)
RNGTOT MATRIX	$\left[k_R\right]$
TDEL MATRIX	$\left[T_\Delta\right]$
RNGLOD MATRIX	$\left[\ell_R\right]$
RC	r_c
RS	r_s
XC	x_c
YC	x_s

RINGER


ENTRY
READ RING DATA
FORM RING STIFFNESS MATRIX
FORM RING THERMAL LOAD MATRIX
FORM ECCENTRICITY COORDINATE TRANSFORMATION MATRIX
RETURN

```
FØR,IS RINGER,RINGER
      SUBRØUTINE RINGER (Q,XN,RNGTØT,RNGLØD,J,ADUS,BADUS,JTIC,JSTØP,
     1                   JTNØ,NSEG)
      INTEGER Q
      DIMENSIØN RNGTØT(4,4),RNGLØD(4,28),TDEL(4,4),XKTØT(4,4),XL(4)
      DIMENSIØN ADUS(30),BADUS(30),JTIC(30),JSTØP(30),JTNØ(28)
      IF (Q.EQ.1) GØ TØ 212
      READ(5,213) JTNØ(J),EA,EIY,EIXY,GJ,EIX,ALPR,RC,XC,YC,XBAR,YBAR,XI,
     1            XØ,TI,TØ,TF
  213 FØRMAT(I2,5E14.7/6E12.5/5E14.7)
      AMN = (TI-TØ)/(XI-XØ)
      BN = ((TØ-TF)*XI-(TI-TF)*XØ)/(XI-XØ)
      WRITE(1) JTNØ(J),EA,EIY,EIXY,GJ,EIX,ALPR,RC,XC,YC,XBAR,YBAR,AMN,BN
      WRITE(6,300) JTNØ(J),EA,EIY,EIXY,GJ,EIX,ALPR,RC,XC,YC,XBAR,YBAR,
     1             XI,XØ,TI,TØ,TF
  300 FØRMAT(/55X,-RING AT JØINT NØ. -,I2//- EA =-,1PE12.5,6X,-EIY =-,
     1 1PE12.5,5X,-EIXY =-,1PE12.5,4X,-GJ =-,1PE12.5,6X,-EIX =-,1PE12.5,
     2 5X,-ALPR =-,1PE12.5/- RC =-,1PE12.5,6X,-XC =-,1PE12.5,6X,-YC =-,
     3 1PE12.5,6X,-XBAR =-,1PE12.5,4X,-YBAR =-,1PE12.5,4X,-XI =-,
     4 1PE12.5/- XØ =-,1PE12.5,6X,-TI =-,1PE12.5,6X,-TØ =-,1PE12.5,6X,
     5 -TFREE =-,1PE12.5)
      GØ TØ 211
  212 READ(1) JTNØ(J),EA,EIY,EIXY,GJ,EIX,ALPR,RC,XC,YC,XBAR,YBAR,AMN,BN
  211 CØNTINUE
      RS = RC+XC
      AM = XN
      AM2 = AM*AM
      AM4 = AM2*AM2
      RCS = RC*RS
      RC2 = RC*RC
      RS2 = RS*RS
      RCS3 = RCS*RS2
      XC2 = XC*XC
      YC2 = YC*YC
      TWØPI = 2.0*3.1415927
      RNGTØT(1,1) = 1.0/RCS*(EA*(XC2*AM4/RS2-2.0*XC*AM2/RS+1.0)+
     1              EIY/RC2*(AM4-2.0*AM2+1.0))
      RNGTØT(2,1) = 1.0/RCS*(EA*YC*AM2*(XC*AM2/RS2-1.0/RS)+EIY*YC*AM2/
     1              (RC2*RS)*(AM2-1.0)+EIXY*AM2/RCS*(AM2-1.0))
      RNGTØT(3,1) = EA*AM/RS2*(-XC*AM2/RS+1.0)
      RNGTØT(4,1) = 1.0/RCS*(EA*YC*(XC*AM2/RS-1.0)+EIY*YC/RC2*
     1              (AM2-1.0)+EIXY/RC*(AM2-1.0))
      RNGTØT(1,2) = RNGTØT(2,1)
      RNGTØT(2,2) = AM4/RCS3*(EA*YC2+EIY*YC*RS+EIX+2.0*EIXY*YC/RC)+
     1              GJ*AM2/(RS2*RS2)
      RNGTØT(3,2) = -EA*YC*AM2*AM/(RS2*RS)
      RNGTØT(4,2) = AM2/(RS2*RC)*(YC2*(EA+EIY/RC2)+EIX+2.0*EIXY*YC/RC
     1              +GJ*RC/RS)
      RNGTØT(1,3) = RNGTØT(3,1)
      RNGTØT(2,3) = RNGTØT(3,2)
      RNGTØT(3,3) = EA*AM2*RC/(RS2*RS)
      RNGTØT(4,3) = -EA*YC*AM/RS2
      RNGTØT(1,4) = RNGTØT(4,1)
      RNGTØT(2,4) = RNGTØT(4,2)
      RNGTØT(3,4) = RNGTØT(4,3)
      RNGTØT(4,4) = 1.0/RCS*(YC2*(EA+EIY/RC2)+EIX+2.0*EIXY*YC/RC)+
     1              GJ*AM2/RS2
      TEM1 = EA*ALPR*(AMN*XC+BN)/RS
      RNGLØD(1,J) = TEM1
      RNGLØD(2,J) = 0.0
      RNGLØD(3,J) = 0.0
```

```
      RNGLØD(4,J) = -TEM1*YC-EIXY*ALPR*AMN/RS
      XBRS = 1.0-XBAR/RS
      TDEL(1,1) = 0.0
      TDEL(2,1) = 0.0
      TDEL(3,1) = -1.0/XBRS
      TDEL(4,1) = 0.0
      TDEL(1,2) = 0.0
      TDEL(2,2) = -1.0
      TDEL(3,2) = -AM*YBAR/(RS*XBRS)
      TDEL(4,2) = 0.0
      TDEL(1,3) = -1.0
      TDEL(2,3) = 0.0
      TDEL(3,3) = -AM*XBAR/(RS*XBRS)
      TDEL(4,3) = 0.0
      TDEL(1,4) = -YBAR
      TDEL(2,4) = +XBAR
      TDEL(3,4) = 0.0
      TDEL(4,4) = -1.0
      DØ 813 L=1,4
      DØ 813 M=1,4
      XKTØT(L,M) = 0.0
      DØ 813 N=1,4
  813 XKTØT(L,M) = XKTØT(L,M)+RNGTØT(L,N)*TDEL(N,M)
      DØ 814 L=1,4
      DØ 814 M=1,4
      RNGTØT(L,M) = 0.0
      DØ 814 N=1,4
  814 RNGTØT(L,M) = RNGTØT(L,M)+TDEL(N,L)*XKTØT(N,M)
      DØ 815 L=1,4
      XL(L) = 0.0
      DØ 815 N=1,4
  815 XL(L) = XL(L)+TDEL(N,L)*RNGLØD(N,J)
      DØ 816 L=1,4
  816 RNGLØD(L,J) = XL(L)
      DØ 1100 L=1,NSEG
      IF (JTNØ(J).EQ.JTIC(L)) GØ TØ 1105
 1100 CØNTINUE
      GØ TØ 1107
 1105 M = JTIC(L)
      RMULT = ADUS(M)*TWØPI
      GØ TØ 1111
 1107 DØ 1101 L=1,NSEG
      IF (JTNØ(J).EQ.JSTØP(L)) GØ TØ 1106
 1101 CØNTINUE
 1106 M = JSTØP(L)
      RMULT = BADUS(M)*TWØPI
 1111 CØNTINUE
      DØ 820 L=1,4
      DØ 820 M=1,4
  820 RNGTØT(L,M) = RNGTØT(L,M)*RMULT
      DØ 821 L=1,4
  821 RNGLØD(L,J) = RNGLØD(L,J)*RMULT
      RETURN
      END
```

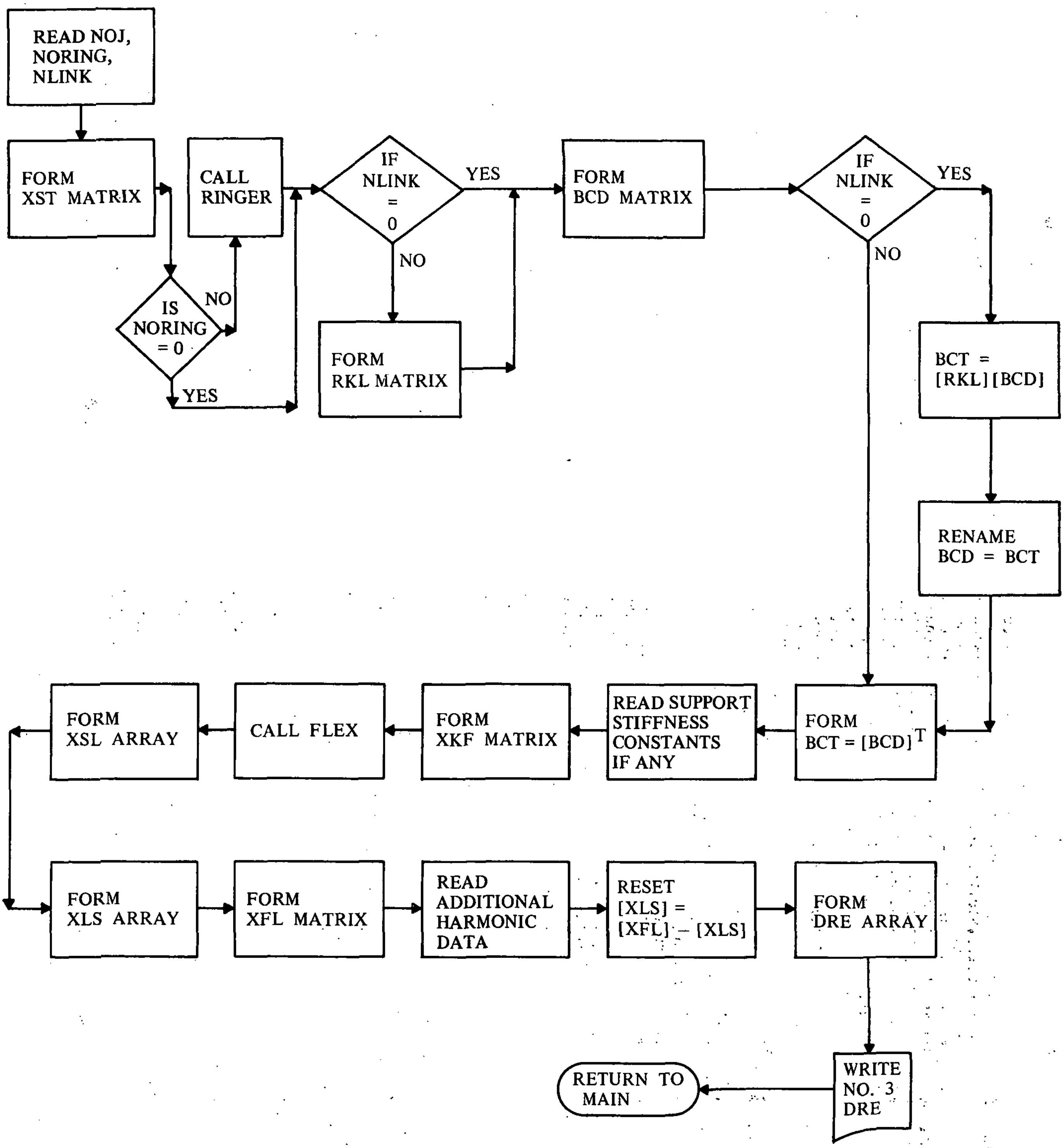
SUBROUTINE STRMAT

The region stiffness matrices, XKR, and the region load matrices, XLR, are passed from REGMAT to STRMAT via Tape #4 and Tape #8, and are placed in the XKSTOT array and the XLSTOT array, respectively. A matrix, BCD, is formed to represent the boundary conditions, and, if kinematic links occur between region the RKL matrix is developed to represent this situation. The subroutine RINGER is again called for discrete ring matrices.

As a result of appropriate matrix operations, a reduced structure stiffness matrix is formed. Subroutine FLEX, a routine identical to SREVN2 (except for being in single precision) with the name changed due to the structure of the OVERLAY option, is called to invert this matrix thus producing A, the flexibili matrix for the structure. The region end deflection array, DRE, is produced as the result of another set of matrix operations.

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
BCD MATRIX	$[BC]$
BCT MATRIX	$[BC]^T$
XST MATRIX	$[\hat{K}]_T$
XKF MATRIX	$[\hat{K}]_F$
A MATRIX	$[\hat{A}]_F$
XSL MATRIX	$[\hat{L}]_T$
XLS ARRAY	$\{\hat{L}\}_F$
XFL ARRAY	$\{\hat{F}\}_F$
DRE ARRAY	$\{\Delta\}_T$

STRMAT


READ NOJ, NORING, NLINK
FORM XST MATRIX
IS NORING = 0
NO
YES
CALL RINGER
IF NLINK = 0
YES
NO
FORM RKL MATRIX
FORM BCD MATRIX
IF NLINK = 0
YES
NO
BCT = [RKL] [BCD]
RENAME BCD = BCT
FORM BCT = [BCD]T
READ SUPPORT STIFFNESS CONSTANTS IF ANY
FORM XKF MATRIX
CALL FLEX
FORM XSL ARRAY
FORM XLS ARRAY
FORM XFL MATRIX
READ ADDITIONAL HARMONIC DATA
RESET [XLS] = [XFL] – [XLS]
FORM DRE ARRAY
WRITE NO. 3 DRE
RETURN TO MAIN

```
FØR,IS STRMAT,STRMAT
      SUBRØUTINE STRMAT
      INTEGER SAVJTC,SAVSTP,Q,THICK
      CØMMØN STØRY(16),TALE(16),XMAT(110,10),STD(10),SADUS(30),RADUS(30)
      CØMMØN TADUS(30),UADUS(30),SAVTIC(900)
      CØMMØN XN,TEFREE,TIC,PHI,STØP,RESTØP,RTICK,G1,XNL
      CØMMØN NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)
      CØMMØN JRSTØP(30),NREG,NSEGTL,NMPT,MATPRP,NCUPLE,NRGEND,NSYM,NRG
      CØMMØN NRC,NSC,NIX,IERRØR,IØUT,MAT,KGEØM,IGEØM,ITYPE,ISTTAB,KELVIN
      CØMMØN IBEGIN,NPRØB,NHARM,NSEG,NERRØR, Q ,NSMAX,THICK
      CØMMØN/HARMØN/ NHRC,IRCNT, HARM(25), HARPØS(25),
     1IHCLUE(2),THEANG(36),NANG,LUNSUM,LUN1,ISWICH,NUMØUT
     2,NHAR
      CØMMØN /RABBIT/ X(100),Y(100,56),LDEF(11),LANG(36),JCYC,INDEX,
     1        NØANG,NØCØRD,NGRAPH,NFLAG,LFLAG,KGM,JAM,JNSC
      INTEGER HARPØS
      DIMENSIØN NØJNT(20),STFCØN(20,4)
      DIMENSIØN SCLA(80),LØC(80)
      DIMENSIØN ICØL(10)
      DIMENSIØN RKL(80,80),ØPEN(4,4)
      DIMENSIØN DLP(4),BCD(80,80),TEMP(80),BCT(80),XKF(80),BC(80)
      DIMENSIØN A(80,80),XSL(80,10),XFL(80,10),DRE(80,10),BCA(80)
      DIMENSIØN XKR(8,8),XSTR(80),XLS(80,10),XLR(8,10)
      DIMENSIØN XST(80,80),XSTBC(80,80),TEMP1(80)
      DIMENSIØN RNGTØT(4,4),RNGLØD(4,28),JTNØ(28)
      DIMENSIØN CØLTTL(2)
      DIMENSIØN LLST(6),SST(1,31)
      EQUIVALENCE (XST(1),BCD(1),A(1),XSTBC(1),RKL(1),XLS(1))
      EQUIVALENCE (XSTR(1),XKF(1),XFL(1),XSL(1),DRE(1),SCLA(1),
     1             TEMP(1),ØPEN(1))
      EQUIVALENCE (XKR(1),XLR(1),BC(1),BCT(1),BCA(1),TEMP1(1),LØC(1))
C
      REWIND  2
      REWIND  3
      REWIND  4
      REWIND  8
      REWIND  9
      PI = 3.1415927
    1 FØRMAT(1H ,8(E14.7,2X)/(3X,8(E14.7,2X)))
  101 FØRMAT (3I5,16A4)
      DATA CØLTTL/4H  CØ,4HLUMN/
      WRITE(6,1726)
 1726 FØRMAT(1H1)
      IF(Q.EQ.1) GØ TØ 540
      READ(5,101) NØJ,NØRING,NLINK
      WRITE(1) NØJ,NØRING,NLINK
      GØ TØ 541
  540 READ(1) NØJ,NØRING,NLINK
  541 NH4 = 4
      NH8=8
      NJTNH4=NØJ*NH4
      DØ 102  J=1,NJTNH4
      DØ 102  I=1,NJTNH4
  102 XST(I,J)=0.0
      DØ 100 NR=1,NREG
      READ(4) ((XKR(I,J),J=1,8),I=1,8)
      J1=JRTIC(NR)
      J2=JRSTØP(NR)
      II=4*(J1-1)
      JJ = 4*(J2-1)+1
      II=II+1
```

```
      DØ 460 JK=1,4
      GØ TØ (451,452,453,454),JK
  451 IX=II
      IND=II
      DØ 461 I=1,4
      DØ 461 J=1,4
  461 ØPEN(I,J)=XKR(I,J)
      GØ TØ 455
  452 IX=II
      IND=JJ
      DØ 462 I=1,4
      DØ 462 J=1,4
  462 ØPEN(I,J)=XKR(I,J+4)
      GØ TØ 455
  453 IX=JJ
      IND=II
      DØ 463 I=1,4
      DØ 463 J=1,4
  463 ØPEN(I,J)=XKR(I+4,J)
      GØ TØ 455
  454 IX=JJ
      IND=JJ
      DØ 464 I=1,4
      DØ 464 J=1,4
  464 ØPEN(I,J)=XKR(I+4,J+4)
  455 DØ 456 I=1,4
      JX=IND
      DØ 457 J=1,4
      XST(IX,JX)=XST(IX,JX)+ØPEN(I,J)
  457 JX=JX+1
  456 IX=IX+1
  460 CØNTINUE
  100 CØNTINUE
      IF (NØRING.EQ.0) GØ TØ 1170
      DØ 1211 J=1,NØRING
      CALL RINGER (Q,XN,RNGTØT,RNGLØD,J,SADUS,UADUS,JRTIC,JRSTØP,JTNØ,
     1             NREG)
      JT = 4*(JTNØ(J)-1)
      DØ 1220 I=1,4
      DØ 1220 IK=1,4
 1220 XST(JT+I,JT+IK) = XST(JT+I,JT+IK)+RNGTØT(I,IK)
 1211 CØNTINUE
      IF (Q.NE.5) GØ TØ 1170
      WRITE(6,300)
  300 FØRMAT(///)
      READ(5,2000)
 2000 FØRMAT(1X)
 1170 CØNTINUE
      DØ 107 I=1,NJTNH4
  107 WRITE (2)  (XST(I,J),J=1,NJTNH4)
      REWIND 2
      REWIND 4
C  GENERATIØN ØF BC BØUNDARY CØNDITIØN SCRAMBLING MATRIX
      IPR = 1
      IF(Q.EQ. 1)IPR=0
      IF(IPR.EQ.0)GØ TØ 220
      WRITE(6,347) NØJ,NLINK
  347 FØRMAT(////51X30HINPUT DATA FØR REGIØN CØUPLING///31X24HNUMBER ØF
     1REGIØN JØINTS ,I3,14X26HNUMBER ØF KINEMATIC LINKS ,I3///44X6HREGIØ
     2N11X8HJØINT(I)11X8HJØINT(J)//)
  220 DØ 348 I = 1,NREG
```

```
      KTIC=JRTIC(I)                                                     1501240
      KSTØP=JRSTØP(I)                                                   1501250
      IF(IPR.EQ.0)GØ TØ 348                                             1501260
      WRITE(6,349) I,KTIC,KSTØP                                         1501240
  349 FØRMAT(46X,I2,2(16X,I3))                                          1501250
  348 CØNTINUE                                                          1501290
      IF(NLINK.EQ.0) GØ TØ 3108                                         1501300
       DØ 756 I=1,NJTNH4                                                1501310
       DØ 756 J=1,NJTNH4                                                1501320
  756 RKL(I,J)=0.0                                                      1501330
      DØ 757 I = 1,NJTNH4                                               1501340
  757 RKL(I,I) = 1.0                                                    1501350
      DØ 789 I=1,4                                                      1501360
       DØ 789 J=1,4                                                     1501370
  789 ØPEN(I,J)=0.0                                                     1501380
      ØPEN(2,2) = 1.0                                                   1501390
      ØPEN(3,3) = 1.0                                                   1501400
      ØPEN(4,4) = 1.0                                                   1501410
      IF(IPR.EQ.1)WRITE(6,1824)                                         1501420
 1824 FØRMAT(//60X,12HREGIØN LINKS//43X,8HJØINT(J),5X,8HJØINT(I),       1501430
     15X,20HANGLE ØF ØRIENTATIØN)                                       1501440
C                                                                       1501450
      DØ 502 NRIG=1,NLINK                                               1501460
      IF(Q.EQ.1)GØ TØ 550                                               1501470
      READ(5,503) JD,JI,CØTAN,(TALE(I),I=1,13)                          1501480
  503 FØRMAT (2I2,E14.7,13A4)                                           1501490
      WRITE(1) JD, JI,CØTAN,(TALE(I), I=1,13)                           1501500
      GØ TØ 560                                                         1501510
  550 READ(1) JD, JI, CØTAN,(TALE(I), I=1,13)                           1501520
      GØ TØ 561                                                         1501530
  560 WRITE(6,1828) JD,JI, CØTAN                                        1501540
 1828 FØRMAT(46X,I2,11X,I2,11X,E14.7)                                   1501550
C                                                                       1501560
  561 IF(NRIG.EQ.1)GØ TØ 605                                            1501570
      IF(JDD .LT. JD)GØ TØ 605                                          1501580
      GØ TØ 8118                                                        1501590
  605 JDD=JD                                                            1501600
C                                                                       1501610
      CØTAN = CØS(CØTAN)/SIN(CØTAN)                                     1501620
      ØPEN(1,1) = SADUS(JD) / SADUS(JI)                                 1501630
      ØPEN(2,4) = - (SADUS(JD)-SADUS(JI))                               1501640
      ØPEN(3,4) = - ØPEN(2,4)* CØTAN                                    1501650
      IXX= JD*4-3                                                       1501660
      DØ 504 I=1,4                                                      1501670
      JXX= JI*4-3                                                       1501680
      DØ 505 J=1,4                                                      1501690
      RKL(IXX,JXX)=ØPEN(I,J)                                            1501700
  505 JXX=JXX+1                                                         1501710
  504 IXX=IXX+1                                                         1501720
  502 CØNTINUE                                                          1501730
      IF (Q.EQ.5) READ(5,2000)                                          1501740
      DØ 781 I=1,NJTNH4                                                 1501750
  781 WRITE (3) (RKL(I,J),J=1,NJTNH4)                                   1501760
      REWIND 3                                                          1501770
 3108 CØNTINUE                                                          1501780
      DØ 108 J=1,NJTNH4                                                 1501790
      DØ 108 I=1,NJTNH4                                                 1501800
  108 BCD(I,J)=0.0                                                      1501810
      ICR =1                                                            1501820
      IF(IPR.EQ.1)WRITE(6,2372)                                         1501830
 2372 FØRMAT(//////57X19HBØUNDARY CØNDITIØNS//30X5HJØINT5X7HDELTA T,5X,7 1501840
```

```
     1HDELTA Z,5X,7HDELTA R,5X,7H THETA ,7X,11HANGLE ALPHA)
      DØ 109 J=1,NØJ
C
      IF(Q.EQ.1) GØ TØ 565
      READ (5,110) JN,DLP(1),DLP(2),DLP(3),DLP(4),ANGLE
      WRITE(1) JN, DLP(1), DLP(2),DLP(3),DLP(4), ANGLE
      GØ TØ 570
  565 READ(1) JN, DLP(1),DLP(2), DLP(3), DLP(4), ANGLE
  110 FØRMAT  (I2,4F2.0,E14.1)
  570 I1= DLP(1)
      I2 = DLP(2)
      I3 = DLP(3)
      I4 = DLP(4)
      IF(IPR.EQ.1)WRITE(6,2373) JN,I1,I2,I3,I4,ANGLE
 2373 FØRMAT(/31X,I3,9X,I2,10X,I2,10X,I2,10X,I2, 7X,E14.7)
      II  = (4*JN)-3
      DØ 121 I=1,4
      IF(DLP(I)-1.0) 113,114,115
  115 IF(DLP(I)-2.0) 116,116,117
  114 BCD(II,ICR)=1.0
      GØTØ 118
  116 BCD(II,ICR)=SIN(ANGLE)
      BCD(II+1,ICR)= -CØS(ANGLE)
      GØTØ 118
  117 BCD(II-1,ICR)=CØS(ANGLE)
      BCD(II,ICR)=SIN(ANGLE)
  118 ICR=ICR+1
  113 II=II+1
  121 CØNTINUE
  109 CØNTINUE
      IF (Q.EQ.5) READ(5,2000)
      ICR=ICR-1
      NZ=ICR
      IF(NLINK.EQ.0) GØ TØ 3124
      DØ 783 N=1,NJTNH4
      READ (3) (TEMP(M),M=1,NJTNH4)
      DØ 782 J=1,NZ
      BCT(J)=0.0
      DØ 782 I=1,NJTNH4
  782 BCT(J)=BCT(J)+TEMP(I)*BCD(I,J)
  783 WRITE (4)  (BCT(L),L=1, NZ)
      REWIND 3
      REWIND 4
      DØ 126 M=1,NJTNH4
  126 READ(4) (BCD(M,N),N=1,NZ)
C     AT THIS PØINT THE BCD ARRAY IS THE PRØDUCT ØF RKL AND BCD ARRAYS
 3124 CØNTINUE
      DØ 124 J=1,NZ
  124 WRITE (3)  (BCD(I,J),I=1,NJTNH4)
      DØ 125 I=1,NJTNH4
  125 WRITE (3)  (BCD(I,J),J=1,NZ)
      REWIND 3
      REWIND 4
C
C     READ SUPPØRT STIFFNESS CØNSTANTS
C
      IF(Q.EQ.1)GØ TØ 141
      READ(5,555)NES,(STØRY(I),I=1,16)
  555 FØRMAT(I4,16A4)
      WRITE(13)NES,(STØRY(I),I=1,16)
      IRCNT = IRCNT+1
```

```
      GØ TØ 142
  141 READ(13)NES,(STØRY(I),I=1,16)
  142 IF(NES.EQ. 0)GØ TØ 152
      IF (Q.EQ.5) WRITE(6,300)
      DØ 150 I=1,NES
      IF(Q.EQ.1)GØ TØ 144
      READ(5,143)NØJNT(I),(STFCØN(I,J),J=1,4)
  143 FØRMAT(I5,4E14.7)
      WRITE(13)NØJNT(I),(STFCØN(I,4),J=1,4)
      IRCNT = IRCNT + 1
      GØ TØ 146
  144 READ(13)NØJNT(I),(STFCØN(I,J),J=1,4)
      GØ TØ 150
  146 CØNTINUE
      WRITE(6,145)NØJNT(I),(STFCØN(I,J),J=1,4)
  145 FØRMAT(/- JØINT NUMBER =-,I2/- STIFFNESS CØNSTANTS-,10X,-T11 =-,
     1 1PE14.7,5X,-T22 =-,1PE14.7,5X,-T33 =-,1PE14.7,5X,-T44 =-,1PE14.7)
  150 CØNTINUE
  152 IF (Q.EQ.5) READ(5,2000)
      DØ 180 L=1,NJTNH4
      READ (2) (XSTR(J),J=1,NJTNH4)
      IF (NES .EQ. 0)GØ TØ 175
      DØ 170 IJ = 1,NES
      IJR = 4*(NØJNT(IJ)-1)
      DØ 1100 J=1,NREG
      IF (NØJNT(IJ).EQ.JRTIC(J)) GØ TØ 1105
 1100 CØNTINUE
      GØ TØ 1107
 1105 NRZ = JRTIC(J)
      RZERØ = SADUS(NRZ)
      GØ TØ 1111
 1107 DØ 1101 J=1,NREG
      IF (NØJNT(IJ).EQ.JRSTØP(J)) GØ TØ 1106
 1101 CØNTINUE
 1106 NRZ = JRSTØP(J)
      RZERØ = UADUS(NRZ)
 1111 CØNTINUE
      DØ 165 II = 1,4
      IF (IJR + II .NE. L)GØ TØ 165
      XSTR(IJR+II) = XSTR(IJR+II)+2.0*PI*RZERØ*STFCØN(IJ,II)
      GØ TØ 175
  165 CØNTINUE
  170 CØNTINUE
C
  175 DØ 184 M=1,NZ
      TEMP1(M) = 0.0
      DØ 181  N=1,NJTNH4
  181 TEMP1(M) = TEMP1(M)+XSTR(N)*BCD(N,M)
  184 CØNTINUE
      WRITE(4) (TEMP1(I),I=1,NZ)
  180 CØNTINUE
      REWIND 4
      DØ 183  II=1,NJTNH4
  183 READ (4) (XSTBC(II,JJ),JJ=1,NZ)
      REWIND 4
      DØ 182  N=1,NZ
      READ (3) (BCT(J),J=1,NJTNH4)
      DØ 185  M=1,NZ
      XKF(M)=0.0
      DØ 186  K=1,NJTNH4
  186 XKF(M)=XKF(M)+BCT(K)*XSTBC(K,M)
```

```
  185 CØNTINUE                                                          1503070
      WRITE (4) (XKF(I),I=1,NZ)                                         1503080
  182 CØNTINUE                                                          1503090
      REWIND 2                                                          1503100
      REWIND 4                                                          1503110
      DØ 187 I=1,NZ                                                     1503120
  187 READ(4) (A(I,J),J=1,NZ)                                           1503130
      CALL FLEX (A,NZ,XSTR,80,NIX)
      IF(NIX.NE.0) GØTØ 8777                                            1503210
      IF(IPR .EQ. 0)GØ TØ 1822                                          1503220
      WRITE(6,1726)                                                     1503230
      WRITE(6,2365)                                                     1503240
 2365 FØRMAT(50X,31H THE REDUCED FLEXIBILITY MATRIX/)                   1503250
 1822 NUMBER = 2                                                        1503260
      JJ = 0                                                            1503270
      JJJ = 0                                                           1503280
 1725 JJ = JJJ + 1                                                      1503290
      JJJ = JJJ + 8                                                     1503300
      MM = 8                                                            1503310
      IF (JJJ.GT.NZ) MM=8-(JJJ-NZ)                                      1503320
      MMM = JJ                                                          1503330
      IF(JJJ.GT.NZ) JJJ=NZ                                              1503340
      DØ 1721 M=1,MM                                                    1503350
      ICØL(M)=MMM                                                       1503360
 1721 MMM = MMM + 1                                                     1503370
      NUMBER = NUMBER + 3                                               1503380
      IF(IPR .EQ. 0)GØ TØ 1823                                          1503390
      WRITE(6,1729) ((CØLTTL,ICØL(M)),M=1,MM)                           1503400
 1729 FØRMAT(/10H   RØW    ,8(2A4,1X,I3,3X)/)                           1503410
 1823 DØ 1722 I=1,NZ                                                    1503420
      NUMBER = NUMBER + 1                                               1503430
      IF(IPR.EQ. 0)GØ TØ 1825                                           1503440
      WRITE(6,1728)I,(A(I,J),J=JJ,JJJ)                                  1503450
 1728 FØRMAT(3X,I3,4X,8(E14.7,1X))                                      1503460
 1825 IF(NUMBER .LT. 55)GØ TØ 1722                                      1503470
      NUMBER = 3                                                        1503480
      IF(IPR.EQ.0)GØ TØ 1722                                            1503490
      WRITE(6,1726)                                                     1503500
      WRITE(6,1729) ((CØLTTL,ICØL(M)),M=1,MM)                           1503510
 1722 CØNTINUE                                                          1503520
      IF(JJJ.NE.NZ) GØ TØ 1725                                          1503530
      DØ 804 L=1,NJTNH4                                                 1503540
      READ(3) (BC(I),I=1,NZ)                                            1503550
      DØ 716 M=1,NZ                                                     1503560
      TEMP(M) = 0.0                                                     1503570
      DØ 805 N=1,NZ                                                     1503580
  805 TEMP(M) = TEMP(M) + BC(N)*A(N,M)                                  1503590
  716 CØNTINUE                                                          1503600
      WRITE (2) (TEMP(I),I=1,NZ)                                        1503610
  804 CØNTINUE                                                          1503620
      REWIND 2                                                          1503630
      REWIND 3                                                          1503640
      DØ 991 J=1,NPRØB                                                  1503650
      DØ 991 I=1,NJTNH4                                                 1503660
  991 XSL(I,J) = 0.0                                                    1503670
 1001 DØ 777 NR=1,NREG                                                  1503680
      J1 = JRTIC(NR)                                                    1503690
      J2 = JRSTØP(NR)                                                   1503700
      READ(8) ((XLR(I,J),J=1,NPRØB),I=1,NH8)                            1503710
      DØ 777 N2 = 1,2                                                   1503720
      GØTØ (11,12),N2                                                   1503730
```

```
   11 II = (J1-1)*NH4+1
      III= II+NH4-1
      GØTØ 3
   12 II = (J2-1)*4+1
      III= II+NH4-1
    3 DØ 777 J=1,NPRØB
      I=0
      IF(N2.EQ.2) I=NH4
      DØ 777 IL=II,III
      I=I+1
  777 XSL(IL,J) = XSL(IL,J)+XLR(I,J)
      IF (NØRING.EQ.0) GØ TØ 1150
      DØ 1225 J=1,NØRING
      JT = 4*(JTNØ(J)-1)
      DØ 1226 I=1,4
      DØ 1226 IK=1,NPRØB
 1226 XSL(JT+I,IK) = XSL(JT+I,IK)+RNGLØD(I,J)
 1225 CØNTINUE
 1150 CØNTINUE
      DØ 876 N=1,NZ
      READ(3) (BCT(J),J=1,NJTNH4)
      DØ 717 M=1,NPRØB
      XLS(N,M) = 0.0
      DØ 806 K=1,NJTNH4
  806 XLS(N,M) = XLS(N,M) + BCT(K)*XSL(K,M)
  717 CØNTINUE
  876 CØNTINUE
      REWIND 3
C
C     JØINT LØAD CØNTRØL CARD
C
      DØ 301 J=1,NPRØB
      DØ 301 I=1,NZ
  301 XFL(I,J) = 0.0
      IF(Q.EQ.1) GØ TØ 355
      READ(5,302)  LINLØD,(STØRY(I),I=1,16)
  302 FØRMAT(I4,16A4)
      WRITE(13) LINLØD,(STØRY(I),I=1,16)
      IRCNT = IRCNT +1
      GØ TØ 360
  355 READ(13) LINLØD,(STØRY(I),I=1,16)
  360 IF(LINLØD.EQ.0)GØ TØ 303
      IF(Q.EQ. 1)GØ TØ 1827
      WRITE(6,341)
  341 FØRMAT(1H1///57X,19HEXTERNAL LINE LØADS///36X,14HPRØBLEM NUMBER,7X
     120HPØINT ØF APPLICATIØN,7X,12HAPPLIED LØAD//)
 1827 DØ 304 N=1,LINLØD
C
      IF(Q.EQ.1) GØ TØ 370
      READ(5,305) JEXT2,JEXT1,XFL(JEXT1,JEXT2)
  305 FØRMAT(2I5,E14.7)
      WRITE(6,342) JEXT2,JEXT1,XFL(JEXT1,JEXT2)
  342 FØRMAT(41X,I3,22X,I3,15X,E14.7)
      WRITE(13) JEXT2, JEXT1, XFL(JEXT1,JEXT2)
      IRCNT = IRCNT + 1
      GØ TØ 304
  370 READ(13) JEXT2, JEXT1,XFL(JEXT1,JEXT2)
  304 CØNTINUE
  303 CØNTINUE
      IF (Q.EQ.5) READ(5,2000)
C
```

```
C      READ LØADS FØR ALL HARMØNIC IF PASS 1                              1504350
C                                                                         1504360
       IF (Q.EQ. 1)GØ TØ 690                                              1504370
       HARPØS(1)= IRCNT                                                   1504380
       IF(NHAR .EQ. 1)GØ TØ 673                                           1504390
       DØ 660 II=2, NHAR                                                  1504400
       IRCNT = 0                                                          1504410
       DØ 645 LLL = 1,NSMAX                                               1504420
       L = 0                                                              1504430
       JJ=1                                                               1504440
       JJJ= 6                                                             1504450
       MM= 1                                                              1504460
       READ(5,608)(LLST(J),J=1,6),NP                                      1504470
   608 FØRMAT(6I1,64X,I2)                                                 1504480
       IRCNT = IRCNT + 1                                                  1504490
       WRITE(13)(LLST(J),J=1,6),( TALE(I), I=1,16)                        1504500
       IF(LLST(1)) 8031,615,610                                           1504510
   610 L=LLST(1)                                                          1504520
   615 JJ= JJ+1                                                           1504530
   631 IF (LLST(JJ))8031,625,620                                          1504540
   620 L= L+1                                                             1504550
   625 IF(JJ .EQ. JJJ)GØ TØ 630                                           1504560
       JJ= JJ+ 1                                                          1504570
       GØ TØ 631                                                          1504580
   630 IF(L.EQ. 0)GØ TØ 645                                               1504590
       DØ 640 M=1,L                                                       1504600
       READ(5, 635)(SST(1,J), J=1,NP)                                     1504610
   635 FØRMAT(5E14.7)                                                     1504620
       IRCNT = IRCNT + 1                                                  1504630
       WRITE(13)(SST(1,J),J=1,NP)                                         1504640
   640 CØNTINUE                                                           1504650
   645 CØNTINUE                                                           1504660
C                                                                         1504670
       READ(5,555)NES,(STØRY(I),I=1,16)                                   1504680
       WRITE(13)NES,(STØRY(I),I=1,16)                                     1504690
       IRCNT = IRCNT + 1                                                  1504700
       IF(NES .EQ. 0)GØ TØ 652                                            1504710
       DØ 656 IK=1,NES                                                    1504720
       READ(5,143)NØJNT(IK),(STFCØN(IK,J),J=1,4)                          1504730
       WRITE(13)NØJNT(IK),(STFCØN(IK,J),J=1,4)                            1504740
       IRCNT = IRCNT + 1                                                  1504750
   656 CØNTINUE                                                           1504760
   652 CØNTINUE                                                           1504770
C                                                                         1504780
       READ(5,302)LNLØD,(TALE(J),J=1,16)                                  1504790
       WRITE(13)LNLØD,(TALE(J),J=1,16)                                    1504800
       IRCNT = IRCNT+1                                                    1504810
       IF(LNLØD .EQ. 0)GØ TØ 655                                          1504820
       DØ 653 LIL=1,LNLØD                                                 1504830
       READ(5,305)JX2,JX1,XXF                                             1504840
       WRITE(13)(JX2,JX1,XXF)                                             1504850
       IRCNT = IRCNT + 1                                                  1504860
   653 CØNTINUE                                                           1504870
   655 HARPØS(II) = IRCNT                                                 1504880
   660 CØNTINUE                                                           1504890
       READ(5,2000)                                                       1504900
C                                                                         1504910
       READ(5,675) NANG
   675 FØRMAT(I2)
       READ(5,678)(THEANG(I),I=1,NANG)                                    1504940
   678 FØRMAT(5E14.0)                                                     1504950
```

```
      IF (NANG .NE. 0)GØ TØ 690                                          1504970
  673 NANG = 1                                                           1504980
      THEANG(1) = 0.                                                     1504990
  690 CØNTINUE                                                           1505000
      KLEW = 0                                                           1505001
      IF (NHRC.NE.1.ØR.NGRAPH.EQ.0) GØ TØ 691                            1505010
      KLEW = 1                                                           1505011
      READ(5,1506) LDEF,LANG                                             1505020
 1506 FØRMAT(11I1,9X,36I1)                                               1505030
      NØANG = 0                                                          1505040
      LIMIT = NANG                                                       1505050
      IF (NHAR.EQ.1) LIMIT = NPRØB                                       1505060
      DØ 15 J=1,LIMIT                                                    1505070
   15 IF (LANG(J).NE.0) NØANG = NØANG+1                                  1505080
      NØCØRD = 0                                                         1505090
      DØ 16 J=1,11                                                       1505100
   16 IF (LDEF(J).NE.0) NØCØRD = NØCØRD+1                                1505110
  691 CØNTINUE                                                           1505120
      IF (KLEW.EQ.0.AND.NHAR.EQ.1) GØ TØ 1600                            1505121
      IF (Q.EQ.5) READ(5,2000)                                           1505130
 1600 REWIND 13                                                          1505140
C                                                                        1505150
C                                                                        1505160
      DØ 811 J=1,NPRØB                                                   1505170
      DØ 811 I=1,NZ                                                      1505180
  811 XLS(I,J)=XFL(I,J)-XLS(I,J)                                         1505190
      REWIND 3                                                           1505200
      DØ 812 J=1,NJTNH4                                                  1505210
      READ (2) (BCA(K),K=1,NZ)                                           1505220
      DØ 813 M=1,NPRØB                                                   1505230
      DRE(J,M)=0.0                                                       1505240
      DØ 813 N=1,NZ                                                      1505250
  813 DRE(J,M)=DRE(J,M)+BCA(N)*XLS(N,M)                                  1505260
  812 CØNTINUE                                                           1505270
      IF(IPR.EQ.0)GØ TØ 1840                                             1505280
      WRITE(6,1726)                                                      1505290
      WRITE(6,2368)                                                      1505300
 2368 FØRMAT(31X,70HTHE EXPANDED REGIØN JØINT DISPLACEMENT MATRIX (REGIØ 1505310
     1N END DEFLECTIØNS))                                                1505320
      WRITE(6,1770)                                                      1505330
 1770 FØRMAT(//14X,5HJØINT,14X,7HPRØBLEM,13X,7HDELTA T,13X,7HDELTA Z,13X 1505340
     1,7HDELTA R,11X,11HØMEGA-THETA)                                     1505350
 1840 NUMBER = 4                                                         1505360
      KK=-3                                                              1505370
      DØ 1735 J=1,NØJ                                                    1505380
      NUMBER = NUMBER + NPRØB + 1                                        1505390
      IF(NUMBER.LT.56) GØ TØ 1745                                        1505400
      IF(IPR.EQ.0)GØ TØ 1843                                             1505410
      WRITE(6,1726)                                                      1505420
      WRITE(6,1770)                                                      1505430
 1843 NUMBER = 2+NPRØB+3                                                 1505440
 1745 KK=KK+4                                                            1505450
      KKK=KK+3                                                           1505460
      IF(IPR.EQ.0)GØ TØ 1735                                             1505470
      WRITE(6,1739)                                                      1505480
 1739 FØRMAT(1H )                                                        1505490
      DØ 1764 L=1,NPRØB                                                  1505500
      WRITE(6,1765) J,L,(DRE(K,L),K=KK,KKK)                              1505510
 1765 FØRMAT(15X,I2,18X,I2,9X,4(3X,E14.7,3X))                            1505520
 1764 CØNTINUE                                                           1505530
 1735 CØNTINUE                                                           1505540
```

```
      DØ 71  NR=1,NREG
      DØ 71  K=1,2
      II =(JRTIC(NR) - 1) *4 +1
      IF(K.EQ.2) II= JRSTØP(NR)*4-3
      III= II + 3
      DØ 71 I = II,III
   71 WRITE(3) (DRE(I,J),J=1,NPRØB)
      REWIND 2
      REWIND 3
      REWIND 4
      GØTØ 7
 8031 IERRØR= 8031
      NERRØR= 9
      NIX= 1
      GØ TØ 7
 8777 IERRØR =8777
      NERRØR=32
      NIX=1
      GØ TØ 7
 8118 IERRØR= 8118
      NERRØR= 42
      NIX=1
    7 RETURN
      END
```

```
FØR,IS FLEX,FLEX
      SUBRØUTINE FLEX  (A,M,LØC,MID,NIX)
      REAL A(MID,1)
      INTEGER LØC(1)
  100 N = M
      DØ 190  K = 1,N
      PIVØT = 0.
      DØ 120  I = K,N
      IF (PIVØT - ABS(A(I,K))) 110,110,120
  110 PIVØT = ABS(A(I,K))
      L = I
  120 CØNTINUE
      IF (PIVØT) 140,130,140
  130 NIX = -1
      GØ TØ 210
  140 LØC(K) = L
      DØ 150  J = 1,N
      TEMP1 = A(K,J)
      A(K,J) = A(L,J)
  150 A(L,J) = TEMP1
      TEMP1 = A(K,K)
      A(K,K) = 1.
      DØ 160  J = 1,N
  160 A(K,J) = A(K,J)/TEMP1
      DØ 190  I = 1,N
      IF (I - K) 170,190,170
  170 TEMP1 = -A(I,K)
      A(I,K) = 0.
      DØ 180   J = 1,N
  180 A(I,J) = A(I,J) + TEMP1*A(K,J)
  190 CØNTINUE
      DØ 200  K = 1,N
      NK = N - K
      L = LØC(NK+1)
      DØ 200  I = 1,N
      TEMP1 = A(I,NK+1)
      A(I,NK+1) = A(I,L)
  200 A(I,L) = TEMP1
      NIX = 0
  210 RETURN
      END
```

SUBROUTINE INITAL

As a result of the matrix operations performed in REGMAT, the SKL22, the XK222 the XK22L2 arrays for each region are passed to INITAL. The XK1112 and XL1 ar for each segment, resulting from the matrix procedures in SEGMAT, are also pas INITAL. The region end deflection matrices, DRE, were formed in STRMAT and are transmitted to INITAL.

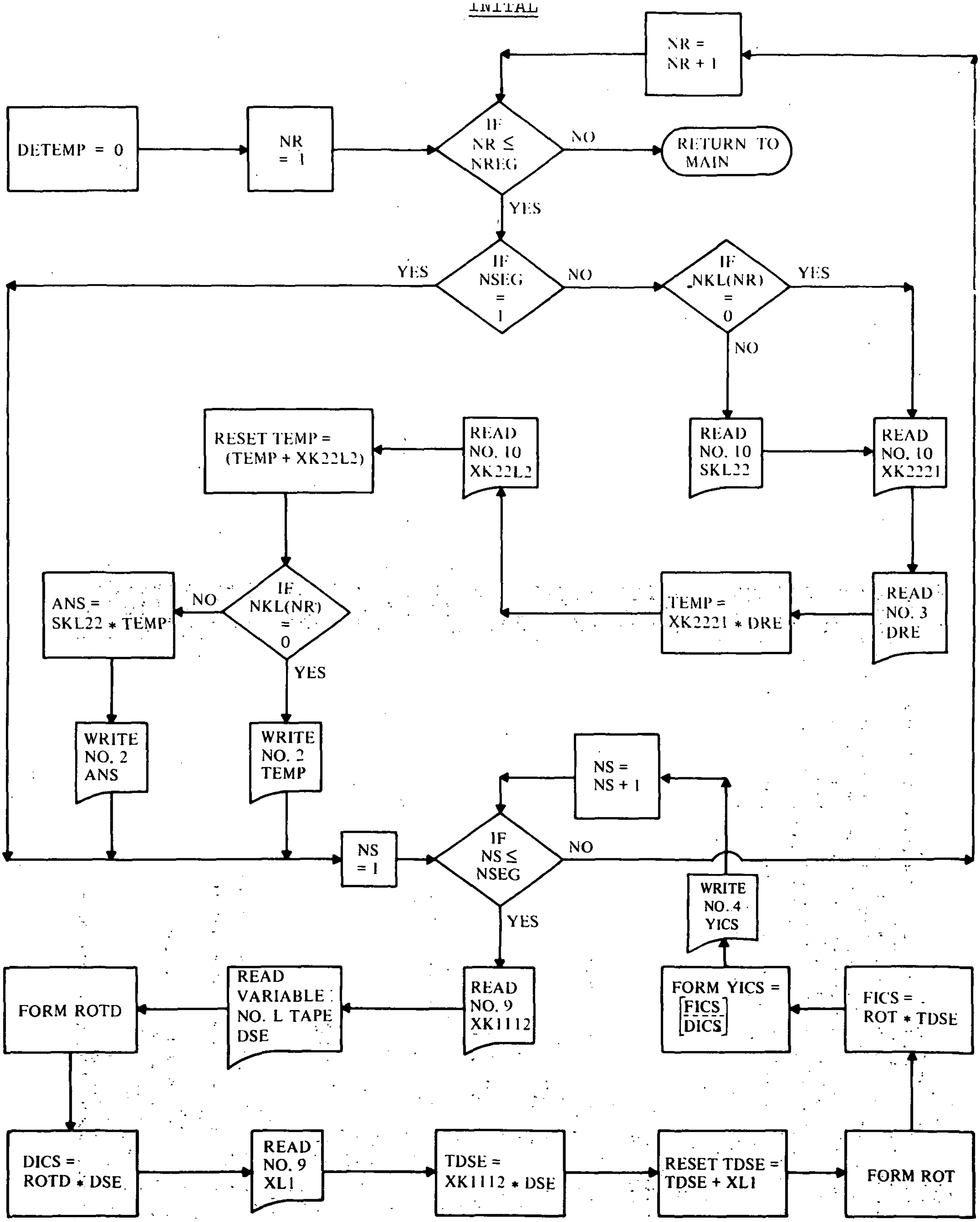
Following appropriate matrix operations upon these arrays, the force initial conc tions, the FICS array, and the deflections initial conditions, the DICS array, ar produced. These arrays combine to form the YICS matrix, which contains the true initial conditions for the structure to be analyzed.

The pertinent counters in the subroutine are:

NS = segment counter

NR = region counter

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
XK2221 MATRIX	$\left[\hat{K}_{22}\right]^{-1} \left[\hat{K}_{21}\right]$
XK22L2 MATRIX	$\left[\hat{K}_{22}\right]^{-1} \left[\hat{L}\right]$
DSE ARRAY	$\left\{\Delta\right\}$
XK1112 MATRIX	$\left[k_{ii} \;\vert\; k_{ij}\right]$
ROTD MATRIX	$\left[IDT\right]^{T}$
DICS ARRAY	$\left\{\delta(i)\right\}$
XL1 ARRAY	$\left\{\ell(i)\right\}$
ROT MATRIX	$\left[IFT\right]^{T}$
FICS ARRAY	$\left\{f(i)\right\}$


DETEMP = 0
NR = 1
IF NR ≤ NREG
NO
RETURN TO MAIN
YES
NR = NR + 1
IF NSEG = 1
YES
NO
IF NKL(NR) = 0
YES
NO
READ NO. 10 SKL22
READ NO. 10 XK2221
READ NO. 3 DRE
TEMP = XK2221 * DRE
READ NO. 10 XK22L2
RESET TEMP = (TEMP + XK22L2)
IF NKL(NR) = 0
NO
YES
ANS = SKL22 * TEMP
WRITE NO. 2 ANS
WRITE NO. 2 TEMP
NS = 1
IF NS ≤ NSEG
NO
YES
NS = NS + 1
READ NO. 9 XK1112
READ VARIABLE NO. L TAPE DSE
FORM ROTD
DICS = ROTD * DSE
READ NO. 9 XL1
TDSE = XK1112 * DSE
RESET TDSE = TDSE + XL1
FORM ROT
FICS = ROT * TDSE
FORM YICS = [FICS] [DICS]
WRITE NO. 4 YICS

```
FØR,IS INITAL,INITAL
      SUBRØUTINE INITAL                                                 1700030
      INTEGER SAVJTC,SAVSTP,Q,THICK
      CØMMØN STØRY(16),TALE(16),XMAT(110,10),STD(10),SADUS(30),RADUS(30) 1700050
      CØMMØN TADUS(30),UADUS(30),SAVTIC(900)                            1700060
      CØMMØN XN,TEFREE,TIC,PHI,STØP,RESTØP,RTICK,G1,XNL                 1700070
      CØMMØN NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)  1700080
      CØMMØN JRSTØP(30),NREG,NSEGTL,NMPT,MATPRP,NCUPLE,NRGEND,NSYM,NRG  1700090
      CØMMØN NRC,NSC,NIX,IERRØR,IØUT,MAT,KGEØM,IGEØM,ITYPE,ISTTAB,KELVIN 1700100
      CØMMØN IBEGIN,NPRØB,NHARM,NSEG,NERRØR, Q ,NSMAX,THICK             1700110
      DIMENSIØN XK2221(112,8),DRE(8,10),TEMP(112,10),XK22L2(112,10)     1700120
      DIMENSIØN XK1112(4,8),DSE(8,10),RØTD(4,4), DICS(4,10)             1700130
      DIMENSIØN TDSE(8,10),YICS(8,10)                                   1700140
      DIMENSIØN XL1(4,10),RØT(4,4),FICS(4,10),SKL22(112,112),ANS(112,10) 1700150
      EQUIVALENCE (RØT(1),RØTD(1)),(TIC,TICK)                           1700160
      EQUIVALENCE (DSE(1),DRE(1)),(XK2221(1),XK22L2(1))                 1700170
      EQUIVALENCE (SKL22(1),XK1112(1)),(YICS(1),TDSE(1))                1700180
      NH4=4*NHARM                                                       1700190
      NH8=8*NHARM                                                       1700210
      REWIND  2                                                         1700230
      REWIND  3                                                         1700240
      REWIND  4                                                         1700250
       REWIND  8                                                        1700260
      REWIND  9                                                         1700270
      REWIND 10                                                         1700280
    1 FØRMAT(1H ,8(E14.7,2X)/(3X,8(E14.7,2X)))                          1700290
      DØ 100 NR=1,NREG                                                  1700300
      NØJ = NST(NR) + NKL(NR) + 1                                       1700310
      ISKL22 = 4*(NØJ-2)                                                1700320
      JSKL22 = 4*(NØJ-2-NKL(NR))                                        1700330
      M8=4*(NØJ-NKL(NR))-8                                              1700350
      NSEG=NST(NR)                                                      1700360
      IF (NSEG.EQ.1) GØTØ 703                                           1700380
      IF(NKL(NR).EQ.0) GØ TØ 415                                        1700390
      DØ 425 I=1,ISKL22                                                 1700400
  425 READ (10) (SKL22(I,J),J=1,JSKL22)                                 1700410
  415 READ(10)  ((XK2221(I,J),J=1,NH8),I=1,M8)                          1700420
      READ(10) (SAVJTC(I),SAVSTP(I),I=1,NSEG)
  703 DØ 91 K = 1,2                                                     1700440
      II = 1                                                            1700450
      IF(K.EQ.2) II=5                                                   1700460
      III = II+3                                                        1700470
      DØ 91 I=II,III                                                    1700480
   91 READ(3) (DRE(I,J),J=1,NPRØB)                                      1700490
      IF (NSEG.EQ.1) GØTØ 999                                           1700500
      DØ 101 J=1,NPRØB                                                  1700510
      DØ 101 I=1,M8                                                     1700520
      TEMP(I,J)=0.0                                                     1700530
      DØ 101 K=1,NH8                                                    1700540
      TEMP(I,J)=TEMP(I,J)+XK2221(I,K)*DRE(K,J)                          1700550
  101 CØNTINUE                                                          1700560
      READ(10)((XK22L2(I,J),J=1,NPRØB),I=1,M8)                          1700570
      DØ 102 J=1,NPRØB                                                  1700580
      DØ 102 I=1,M8                                                     1700590
  102 TEMP(I,J)= -(TEMP(I,J)+XK22L2(I,J))                               1700600
      IF(NKL(NR).EQ.0) GØ TØ 435                                        1700610
      DØ 445 I = 1,ISKL22                                               1700620
      DØ 445 J=1,NPRØB                                                  1700630
      ANS(I,J)=0.0                                                      1700640
      DØ 445 K = 1,JSKL22                                               1700650
  445 ANS(I,J)=ANS(I,J)+SKL22(I,K)*TEMP(K,J)                            1700660
```

```
 435 DØ 391 N=1,NSEG
     IF((N.EQ.1.ØR.N.EQ.NSEG).AND.SAVJTC(N).GT.SAVSTP(N)) GØ TØ 370
     DØ 398 K=1,2
     IF (N.NE.1.ØR.K.NE.1) GØTØ 393
     DØ 394 I= 1,4
 394 WRITE (2) (DRE(I,J),J=1,NPRØB)
     GØ TØ 398
 393 IF(N.EQ.NSEG.AND.K.EQ.2) GØTØ 395
     IF (K.EQ.1) II = SAVJTC(N)*4-7
     IF (K.EQ.2) II = SAVSTP(N)*4-7
     III = II + 3
     DØ 397 I=II,III
     IF (NKL(NR).EQ.0) GØTØ 392
     WRITE (2) (ANS(I,J),J=1,NPRØB)
     GØTØ 397
 392 WRITE (2) (TEMP(I,J),J=1,NPRØB)
 397 CØNTINUE
     GØ TØ 398
 395 DØ 396 I=5,8
 396 WRITE (2)  (DRE(I,J),J=1,NPRØB)
 398 CØNTINUE
     GØ TØ 391
 370 IF(N.EQ.NSEG) GØ TØ 380
     IF(NKL(NR).EQ.0) GØ TØ 375
     DØ 371 I=1,4
 371 WRITE(2) (ANS(I,J),J=1,NPRØB)
     GØ TØ 376
 375 DØ 372 I=1,4
 372 WRITE(2) (TEMP(I,J),J=1,NPRØB)
 376 DØ 373 I=1,4
 373 WRITE(2) (DRE(I,J),J=1,NPRØB)
      GØ TØ 391
 380 II =M8 - 3
      III = M8
      DØ 381 I=5,8
 381 WRITE(2) (DRE(I,J),J=1,NPRØB)
      IF(NKL(NR).EQ.0) GØ TØ 385
      DØ 382 I=II,III
 382 WRITE(2) (ANS(I,J),J=1,NPRØB)
      GØ TØ 391
 385 DØ 383 I=II,III
 383 WRITE(2) (TEMP(I,J),J=1,NPRØB)
 391 CØNTINUE
     REWIND 2
 999 DØ 201 NS=1,NSEG
     READ  (9) ((XK1112(I,J),J=1,NH8),I=1,NH4),IGEØM,G1
     ISEG=0
     NRI=NR-1
     IF(NR1.EQ.0)GØTØ8
     DØ 7 I=1,NR1
   7 ISEG=ISEG+NST(I)
   8 ISEG=ISEG+NS
     TIC= SAVTIC(ISEG)
     GØ TØ (21,22,23),IGEØM
  21 SN = SIN(TIC)
     CS=CØS(TIC)
     GØ TØ 25
  22 SN = CØS(1.570796-G1)
     CS = SIN(1.570796-G1)
     GØ TØ 25
  23 SN = 1.0
```

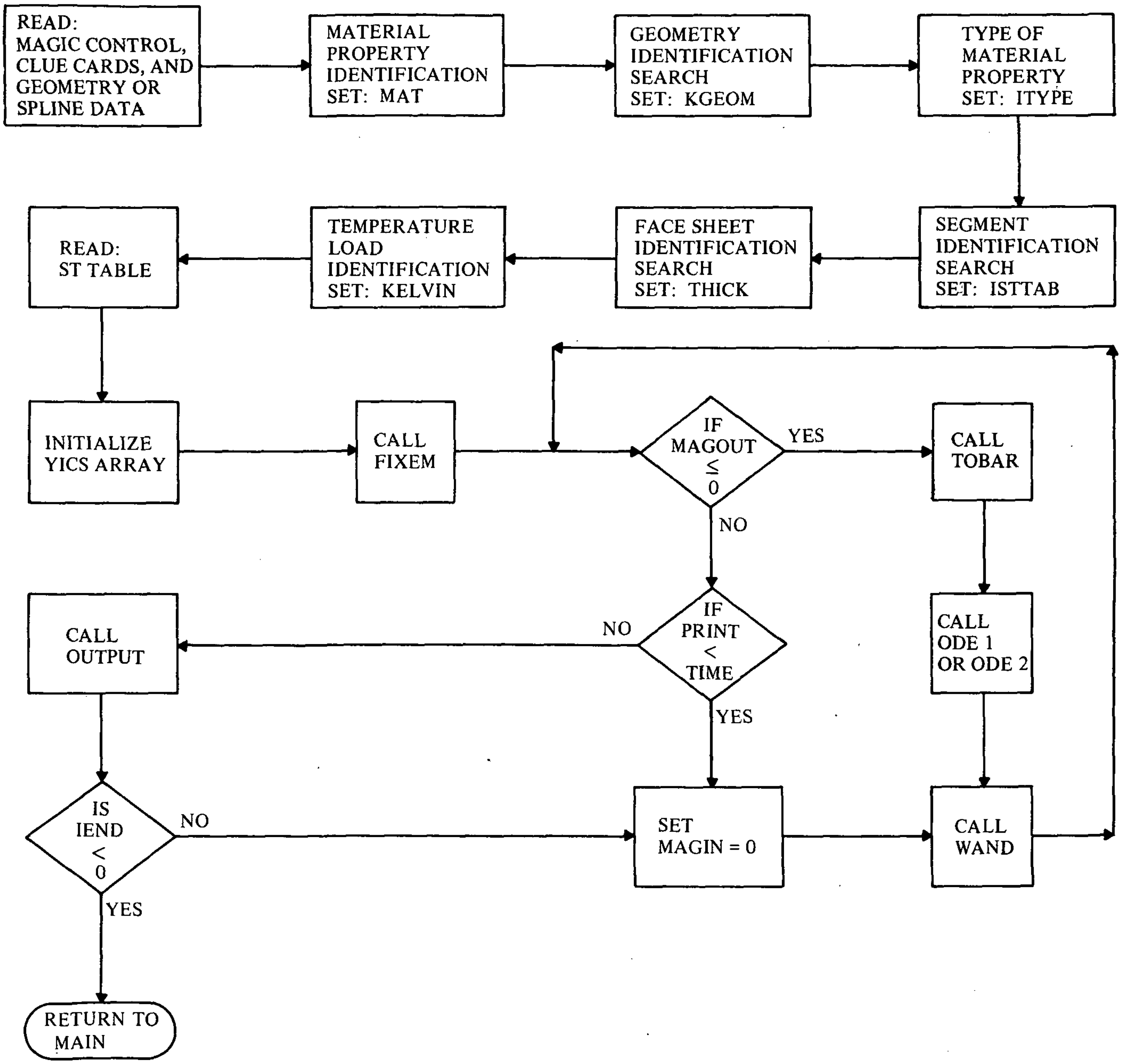
```
      CS = 0.0
   25 CØNTINUE
      IF (NSEG.EQ.1) GØ TØ 80
      DØ 78 I = 1,8
   78 READ (2) (DSE(I,J),J=1,NPRØB)
   80 CØNTINUE
      DØ 302 J=1,NH4
      DØ 302 I=1,NH4
  302 RØTD(I,J)=0.0
      DØ 305 J=1,NH4,4
      RØTD(J,J)=1.0
      RØTD(J+1,J+2)=CS
      RØTD(J+2,J+1)=-CS
      RØTD(J+1,J+1)=-SN
      RØTD(J+2,J+2)=-SN
  305 RØTD(J+3,J+3)=1.0
      DØ 306 J=1,NPRØB
      DØ 306 I=1,NH4
      DICS(I,J)=0.0
      DØ 306 K=1,NH4
  306 DICS(I,J)=DICS(I,J)+RØTD(I,K)*DSE(K,J)
      READ (9) ((XL1(I,J),J=1,NPRØB),I=1,NH4)
      DØ 202 J=1,NPRØB
      DØ 202 I=1,NH4
      TDSE(I,J)=0.0
      DØ 202 K=1,NH8
  202 TDSE(I,J)=TDSE(I,J)+XK1112(I,K)*DSE(K,J)
      DØ 203 J=1,NPRØB
      DØ 203 I=1,NH4
  203 TDSE(I,J)=TDSE(I,J)+XL1(I,J)
      DØ 301 J=1,NH4
      DØ 301 I=1,NH4
  301 RØTD(I,J)=0.0
      DØ 204 J=1,NH4,4
      RØT(J,J)=-1.0
      RØT(J+1,J+2)=-CS
      RØT(J+2,J+1)= CS
      RØT(J+1,J+1)=SN
      RØT(J+2,J+2)=SN
  204 RØT(J+3,J+3)=1.0
      DØ 205 J=1,NPRØB
      DØ 205 I=1,NH4
      FICS(I,J)=0.0
      DØ 205 K=1,NH4
  205 FICS(I,J)=RØT(I,K)*TDSE(K,J)+FICS(I,J)
      DØ 402 J=1,NPRØB
      DØ 402 I=1,NH4
      II=I+NH4
      YICS(I,J)=FICS(I,J)
  402 YICS(II,J)=DICS(I,J)
      WRITE(4)    ((YICS(I,J),I=1,8),J=1,NPRØB)
  201 CØNTINUE
      REWIND 2
  100 CØNTINUE
      REWIND  1
      REWIND  4
       REWIND  8
      RETURN
       END
```

SUBROUTINE LEBEGE

The subroutine link LEBEGE receives the YICS array for each segment from INITAI via Tape #4. The subroutine FIXEM is called to integrate the differential equations of each segment, under true load conditions. FIXEM is identical to subroutine SETUP, while WAND corresponds to subroutine MAGIC and only consideration of the OVERLAY structure dictates the change in names. The subroutines TOBAR, TEMOEG, PLYCO, and PLYNE are similarly equivalent to ROBOT, GEOMET, PLICO, and PLINE discussed previously.

The results of the final integration sequence are the forces and deflections at the beginning, intermediate, and end points of each segment. These are passed to the subroutine OUTPUT.

LEBEGE


READ:
MAGIC CONTROL,
CLUE CARDS, AND
GEOMETRY OR
SPLINE DATA
MATERIAL
PROPERTY
IDENTIFICATION
SET: MAT
GEOMETRY
IDENTIFICATION
SEARCH
SET: KGEOM
TYPE OF
MATERIAL
PROPERTY
SET: ITYPE
SEGMENT
IDENTIFICATION
SEARCH
SET: ISTTAB
FACE SHEET
IDENTIFICATION
SEARCH
SET: THICK
TEMPERATURE
LOAD
IDENTIFICATION
SET: KELVIN
READ:
ST TABLE
INITIALIZE
YICS ARRAY
CALL
FIXEM
IF
MAGOUT
≤
0
YES
NO
CALL
TOBAR
CALL
ODE 1
OR ODE 2
IF
PRINT
<
TIME
NO
YES
CALL
OUTPUT
IS
IEND
<
0
NO
YES
SET
MAGIN = 0
CALL
WAND
RETURN TO
MAIN

```
FØR,IS LEBEGE,LEBEGE
      SUBRØUTINE LEBEGE                                                 1800030
      INTEGER SAVJTC,SAVSTP,SEGTAB, Q ,THICK,TYPE                       1800040
      CØMMØN STØRY(16),TALE(16),XMAT(110,10),STD(10),SADUS(30),RADUS(30) 1800050
      CØMMØN TADUS(30),UADUS(30),SAVTIC(900)                            1800060
      CØMMØN XN,TEFREE,TIC,PHI,STØP,RESTØP,RTICK,G1,XNL                 1800070
      CØMMØN NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)  1800080
      CØMMØN JRSTØP(30),NREG,NSEGTL,NMPT,MATPRP,NCUPLE,NRGEND,NSYM,NRG  1800090
      CØMMØN NRC,NSC,NIX,IERRØR,IØUT,MAT,KGEØM,IGEØM,ITYPE,ISTTAB,KELVIN 1800100
      CØMMØN IBEGIN,NPRØB,NHARM,NSEG,NERRØR, Q ,NSMAX,THICK             1800110
      CØMMØN/HARMØN/ NHRC,IRCNT, HARM(25), HARPØS(25),                  1800120
     1IHCLUE(2),THEANG(36),NANG,LUNSUM,LUN1,ISWICH,NUMØUT               1800130
     2,NHAR                                                             1800140
      CØMMØN /RABBIT/ X(100),Y(100,56),LDEF(11),LANG(36),JCYC,INDEX,    1800150
     1       NØANG,NØCØRD,NGRAPH,NFLAG,LFLAG,KGM,JAM,JNSC               1800160
      CØMMØN /ARING/ NRING(28)                                          1800170
      INTEGER HARPØS                                                    1800180
      CØMMØN/NAM1/FACE(4),STRGØ(7),THERM(4),EQUATE(3),                  1800200
     1 STRESS(5),MATER(3),SEGTAB(12)                                    1800210
      EQUIVALENCE (XMTTH,XMTETH),(XMTPH,XMTEPH),(XNTTH,XNTETH),         1800220
     1              (XNTPH,XNTEPH)                                      1800230
      EQUIVALENCE  (XNPHI,XNPI)                                         1800240
      DIMENSIØN LST(61)
      DIMENSIØN        YDEV( 80),YICS( 80),YNEW( 80)                    1800260
      DIMENSIØN TBDEL( 80),           FWDEL( 80)                        1800270
      DIMENSIØN YCØRR(80)                                               1800280
      DIMENSIØN KLUE(4)                                                 1800300
      DIMENSIØN ST(72,31),XLAYER(10)                                    1800310
      DIMENSIØN TMPAV(5)                                                1800320
      DØUBLE  PRECISIØN  YNEW,YPRED                                     1800330
      CØMMØN /LASTEQ/ YPRED( 80),YDØT( 80),YASAVE( 80),                 1800340
     1                YANTH,YAMTH,YAMPT,YANPT,YAØPH,YAQPH,YAQTH,YAJPH,  1800350
     2                S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,        1800360
     3                X1RØ,X1RØSQ,X1SNRØ,X1CSRØ,CN1RØ,SN1RØ,CS1RØ,      1800370
     4                X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RØ,BESQ,  1800380
     5   RØSQ,XNSQ,BETA,R1,R2,S1,R1DØT,R1SQ,                            1800390
     6                XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,     1800400
     7  XMTHLD,XMPHLD,ETHET(2),EPHI(2),XGPT(2),ALPHTH(2),ALPHPH(2),     1800410
     8                XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,   1800420
     9                XK11,XK12,XK21,XK22,XK33,XD11,                    1800430
     A                  M,I,SITIN,SITØUT,SIPIN,SIPØUT,TPTIN,TPTØUT,     1800440
     B              ZBRIN,ZBRØUT,SCRIPA,SCRIPI,SIFIN,SIFØUT,TZEPH,TZETH 1800450
     C,XNPHI,BETTA,XC16,XC14,XC25                                       1800460
      CØMMØN /SNILPS/ ANG,PSI(100),RAD(100),CUR1(100),CUR2(100),        1800470
     1     DR1DP(100),ZI(14),RI(14),NRZIN                               1800480
      KKELV= 0                                                          1800530
      THK = 0.                                                          1800560
      REWIND  1                                                         1800570
  600 FØRMAT(1H ,8(E14.7,2X)/(3X,8(E14.7,2X)))                          1800580
      REWIND 13                                                         1800590
      ISKIP= 0                                                          1800600
      IF(NHRC .EQ. 1)GØ TØ 930                                          1800610
      NN =NHRC-1                                                        1800620
      DØ 920 I=1,NN                                                     1800630
      ISKIP= ISKIP+ HARPØS(I)                                           1800640
  920 CØNTINUE                                                          1800650
      DØ 925 I= 1, ISKIP                                                1800660
      READ(13) DUMMY                                                    1800670
  925 CØNTINUE                                                          1800680
  930 CØNTINUE                                                          1800690
      KSC = 0                                                           1800700
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```
      JAM =1                                                            1800710
      JNSC =0                                                           1800720
      DØ 451 I=1,NREG                                                   1800730
  451 KSC = KSC + NST(I)                                                1800740
      LSC = 0                                                           1800750
  902 LSC = LSC + 1                                                     1800760
      JCYC = 0                                                          1800770
      XNTTH = 0.0                                                       1800830
      XNTPH = 0.0                                                       1800840
      XMTTH = 0.0                                                       1800850
      XMTPH = 0.0                                                       1800860
      XNL = 0.0                                                         1800870
      NSC=LSC                                                           1800880
      JNSC=JNSC+1                                                       1800890
      IF(JNSC.LE.NST(JAM)) GØ TØ 1727                                   1800900
      NRNG = NRING(JAM)                                                 1800910
      IF (NRNG.EQ.0) GØ TØ 1900                                         1800920
      DØ 1901 I=1,NRNG                                                  1800930
 1901 READ(1) DUMLNK                                                    1800940
 1900 CØNTINUE                                                          1800950
      NNSKL = NKL(JAM)                                                  1800960
      IF(NNSKL .EQ. 0)GØ TØ 1724                                        1800970
      DØ 1725 I = 1,NNSKL                                               1800980
      READ(1)DUMLNK                                                     1800990
 1725 CØNTINUE                                                          1801000
 1724 JAM=JAM+1                                                         1801010
      JNSC=1                                                            1801020
 1727 CØNTINUE                                                          1801030
      IØUT = 1                                                          1801040
      READ(1) RGØ,ANG,STØRY                                             1801050
      READ(1)DTAU,DIFF,STEP,DELTA                                       1801060
      IF (RGØ.EQ.14.0) GØ TØ 182                                        1801070
      READ(1)        G1,G2,G3                                           1801080
      GØ TØ 183                                                         1801090
  182 READ(1) NRZIN,(ZI(J),RI(J),J=1,NRZIN)                             1801100
  183 CØNTINUE                                                          1801110
      READ(1)        TYPE,HLAYR,SHEET,INTERP,RANKIN,TEFREE,ANALYS,NP    1801120
      EPSIL =1.0E-05                                                    1801140
      ERR = 1.0 E-07                                                    1801150
      I = RGØ                                                           1801160
      IPR = 1                                                           1801170
      IF(IHCLUE(2) .EQ. 1 .AND. NHRC .NE. NHAR)IPR=0                    1801180
      IF(IPR.EQ. 0) GØ TØ 615                                           1801190
      WRITE(6,1726)                                                     1801200
 1726 FØRMAT(1H1)                                                       1801210
      IF(JNSC.EQ.1) WRITE(6,606) JAM,NST(JAM),NKL(JAM)                  1801220
  606 FØRMAT(//58X,13HREGIØN NUMBER,I3//35X,10HTHERE ARE ,I2,14H SEGMENT 1801230
     1S AND ,I2,35H KINEMATIC LINKS WITHIN THIS REGIØN)                 1801240
      WRITE(6,651)  JNSC,I  ,(STØRY(I),I=1,16)                          1801250
  651 FØRMAT(//13X,15HSEGMENT NUMBER ,I2,5X,13HSEGMENT CØDE ,I2,5X,     1801260
     116A4)                                                             1801270
C     MATERIAL PRØPERTY IDENTIFICATIØN                                  1801280
  615 DØ 501 I = 1,NMPT                                                 1801290
      IF (HLAYR-STD(I)) 501,502,501                                     1801300
  502 MAT=I                                                             1801310
      GØTØ 503                                                          1801320
  501 CØNTINUE                                                          1801330
      GØTØ 8036                                                         1801340
  503 CØNTINUE                                                          1801350
C     GEØMETRY IDENTIFICATIØN SEARCH                                    1801360
      DØ 504 I=1,7                                                      1801370
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      IF(RGØ-STRGØ(I)) 504,505,504
  504 CØNTINUE
      GØTØ 8086
  505 KGEØM=I
      IGEØM = 0
      IF (KGEØM.EQ.1.ØR.KGEØM.EQ.2.ØR.KGEØM.EQ.5.ØR.KGEØM.EQ.6) IGEØM =1
      IF (KGEØM.EQ.3) IGEØM=2
      IF(KGEØM.EQ.4) IGEØM=3
      IF ( KGEØM.EQ.7 ) IGEØM = 1
      DØ 506 I=1,3
      IF(TYPE-MATER(I))506,507,506
  506 CØNTINUE
      GØTØ 8087
  507 ITYPE=I
      DØ 510 I=1,12
      IF(INTERP-SEGTAB(I))510,511,510
  510 CØNTINUE
      GØ TØ 8088
  511 ISTTAB=I
      DØ 508 I=1,4
      IF (SHEET-FACE(I)) 508,509,508
  508 CØNTINUE
      GØTØ 8089
  509 THICK=I
      KLUE2=1
      GØ TØ (430,430,420,420,420,420,425,425,425, 430,430,430),ISTTAB
  420 KLUE2=2
      GØ TØ 430
  425 KLUE2=3
  430 KLUE1=THICK
C
C     TEMPERATURE LØAD IDENTIFICATIØN
      DØ 401 I=1,4
      IF (RANKIN-THERM(I)) 401,402,401
  401 CØNTINUE
      GØTØ 8090
  402 KELVIN=I
      KSWICH = 0
      IF(HARM(1).EQ.0..AND. KELVIN .NE. 2)KSWICH = 1
      IF(NHAR.EQ.1)KSWICH=0
C     LINEAR ØR NØNLINEAR ANALYSIS IDENTIFICATIØN
      DØ 403 I=1,3
      IF (ANALYS-EQUATE(I)) 403,404,403
  403 CØNTINUE
      GØTØ 8013
  404 IANLYZ=I
      IF (IANLYZ.NE.1.AND.NPRØB.GT.1) GØTØ 8009
      IF(IANLYZ.NE.1) XNL = 1.0
      IF(XNL.NE.0.0.AND.XN.NE.0.0) GØ TØ 8501
      NRØW = 0
      NRØW = THICK + 1
C
      IF (ISTTAB.EQ.1) NRØW = 11
      IF(ISTTAB.EQ.3)NRØW=13
      IF(ISTTAB.EQ.4.ØR.ISTTAB.EQ.7)NRØW=7
      IF(ISTTAB.EQ.5.ØR.ISTTAB.EQ.8)NRØW=8
      IF(ISTTAB.EQ.6.ØR.ISTTAB.EQ.9)NRØW=9
      IF(ISTTAB.EQ.10)NRØW=12
      IF(ISTTAB.EQ.11)NRØW=13
      IF(ISTTAB.EQ.12)NRØW=14
C
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      IF (IPR .EQ. 0)GØ TØ 617                                          1801990
      WRITE(6,655)                                                      1802000
  655 FØRMAT(//42X,47HTABLE ØRDER PHI ØR S VS. CRØSSECTIØN PRØPERTIES)  1802010
  617 DØ 901 I = 1,NRØW                                                 1802020
      READ(1)        (ST(I,J),J=1,NP)                                   1802030
      IF (IPR .EQ. 0)GØ TØ 901                                          1802040
      WRITE(6,600)  (ST(I,J),J=1,NP)                                    1802050
  901 CØNTINUE                                                          1802060
      TIC = ST(1,1)                                                     1802070
      STØP = ST(1,NP)                                                   1802080
      K=NRØW+1                                                          1802090
      KK = NRØW                                                         1802061
      JJ=1                                                              1802100
      JJJ=6                                                             1802110
      MM=1                                                              1802120
      DØ 17 NLC=1,NPRØB                                                 1802130
      JT = JJ                                                           1802140
      JTT= JJJ                                                          1802150
      L=0                                                               1802160
      READ(13)(LST(J),J= JJ,JJJ),(TALE(I),I=1,16)                       1802170
      IF(LST(JJ))8031,19,20                                             1802180
   20 L = LST(JJ)                                                       1802190
      IF(NLC.GT.1.AND.LST(JT).NE.0) GØ TØ 8008                          1802200
   19 JJ=JJ+1                                                           1802210
   23 IF(LST(JJ))8031,22,21                                             1802220
   21 L=L+1                                                             1802230
   22 IF(JJ.EQ.JJJ) GØTØ 24                                             1802240
      JJ=JJ+1                                                           1802250
      GØTØ 23                                                           1802260
   24 IF(L.EQ.0) GØ TØ 71                                               1802270
      KK = K + L - 1                                                    1802280
      DØ 72 M=K,KK                                                      1802290
      READ(13)(ST(M,J),J=1,NP)                                          1802300
   72 CØNTINUE                                                          1802310
      IF(NLC.GT.1.ØR.LST(1).EQ.0) GØ TØ 660                             1802320
      IF(IPR.EQ. 0)GØ TØ 691                                            1802330
      WRITE(6,656)                                                      1802340
  656 FØRMAT(//45X,42HTABLE ØRDER PHI ØR S VS. TEMPERATURE LØADS,)      1802350
  691 KY=K                                                              1802360
      KZ = K + LST(1) -1                                                1802370
      IF(IPR.EQ. 0)GØ TØ 692                                            1802380
      DØ 657 N=KY,KZ                                                    1802390
      WRITE(6,600) (ST(N,J),J=1,NP)                                     1802400
  657 CØNTINUE                                                          1802410
  692 K=KZ+1                                                            1802420
  660 IF((L-LST(JT)).EQ.0) GØ TØ 665                                    1802430
      IF (IPR .EQ. 0)GØ TØ 665                                          1802440
      WRITE(6,661) NLC                                                  1802450
  661 FØRMAT(//16X,8HPRØBLEM ,I2,5X,84HTABLE ØRDER  PHI ØR S VS. DISTRIB 1802460
     1UTED LØADS (F THETA, F PHI, F ZETA, M THETA, M PHI),)             1802470
      WRITE(6,1968) (LST(J),J=JT,JTT)                                   1802480
 1968 FØRMAT(27H LØAD IDENTIFICATIØN CLUES ,6I1/)                       1802490
      DØ 662 N = K, KK                                                  1802500
      WRITE(6,600) (ST(N,J),J=1,NP)                                     1802510
  662 CØNTINUE                                                          1802520
  665 CØNTINUE                                                          1802530
   71 K = K + L - LST(JT)                                               1802540
      JJ=JJJ+1                                                          1802550
      JJJ=JJ+5                                                          1802560
   17 MM=MM+1                                                           1802570
      IF(IANLYZ.EQ.1) GØ TØ 590                                         1802580
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      KK = KK + 1                                                       1802590
      IF ( L.EQ.0 ) KK = NRØW + 1                                       1802600
      READ(1)  (ST(KK,J),J=1,NP)                                        1802610
      IF (IPR .EQ. 0)GØ TØ 590                                          1802620
      WRITE(6,666) (ST(KK,J),J=1,NP)                                    1802630
  666 FØRMAT(//47X,38HASSUMED NØN-LINEAR VALUES VS. PHI ØR S//(1H ,     1802640
     18(E14.7,2X)))                                                     1802650
  590 CØNTINUE                                                          1802660
      NSAVE = NRØW                                                      1802670
      JJ=NPRØB*6                                                        1802680
      LT=0                                                              1802690
      DØ 15  J=1,JJ                                                     1802700
   15 LT=LT+LST(J)                                                      1802710
      NTØTAL=LT+NSAVE                                                   1802720
      IF(XNL.EQ.1.0) NTØTAL = NTØTAL + 1                                1802730
      IF (ISTTAB.LE.3) GØ TØ 592                                        1802740
  591 IF (ISTTAB.GT.3.AND.ISTTAB.LE.9) GØ TØ 594                        1802750
  593 CØNTINUE                                                          1802730
      K = KK+1                                                          1802770
      KK=KK+4                                                           1802780
      NTØTAL=NTØTAL+4                                                   1802790
      GØ TØ 595                                                         1802800
  594 CØNTINUE                                                          1802780
      K = KK+1                                                          1802820
      KK=KK+2                                                           1802830
      NTØTAL=NTØTAL+2                                                   1802840
  595 READ(1)VAR1                                                       1802850
      READ(1) (KLUE(I),I=1,4)                                           1802860
      DØ 596 I=K,KK                                                     1802870
  596 READ(1)  (ST(I,J),J=1,NP)                                         1802880
  592 CØNTINUE                                                          1802890
      NEQNS=8*NPRØB                                                     1802900
      READ(1) IS,SAVJTC(IS),SAVSTP(IS),STØRY                            1802910
      DØ 73 I=1,NEQNS                                                   1802920
   73 YICS(I)=0.0                                                       1802930
      READ(4)     (YICS(I),I=1,NEQNS)                                   1802940
      NCYC=0                                                            1802950
      NSAVE=NRØW                                                        1802960
      IEND=0                                                            1802970
      PRINT=TIC                                                         1802980
      DTA=DTAU                                                          1802990
      DTAU=0.0                                                          1803000
      KMAG=0                                                            1803030
      IF(KSWICH.EQ.1)READ(1)(TMPAV(I),I=1,5)                            1803040
   59 CALL FIXEM (MAGIN,MAGØUT,TIC,STEP,NEQNS,DTAU,EPSIL,DELTA,ERR,TIME, 1803050
     1DTIME,YICS,YPRED,YCØRR,YDØT,YNEW,YDEV,FWDEL,TBDEL,KMAG)           1803060
      GØTØ  61                                                          1803070
   60 CALL WAND(MAGIN,MAGØUT,TIC,STEP,NEQNS,DTAU,EPSIL,DELTA,ERR,TIME,  1803080
     1DTIME,YICS,YPRED,YCØRR,YDØT,YNEW,YDEV,FWDEL,TBDEL,KMAG)           1803090
   61 IF(MAGØUT.LE.0) GØTØ 25                                           1803120
      IF(TIME.GT.STØP) GØTØ 62                                          1803130
      IF(TIME.LT.STØP) GØTØ 63                                          1803140
   64 IEND=-1                                                           1803150
      GØTØ 67                                                           1803160
   62 IF(TIME.LE.(STØP+DIFF)) GØTØ 64                                   1803170
      GØTØ 8001                                                         1803180
   63 IF((STØP-DIFF).LE.TIME) GØTØ 64                                   1803190
      IF((TIME+DTIME).GT.STØP) GØTØ 65                                  1803200
      IF(PRINT.GT.TIME) GØTØ 66                                         1803210
      PRINT=TIME+DTA                                                    1803220
   67 IF(IØUT.NE.0) GØTØ 110                                            1803230
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6450 IF(IEND.GT.0) GØ TØ 8002                                            1803240
     IF(IEND.LT.0) GØTØ  150                                             1803250
  66 MAGIN=0                                                             1803260
     GØTØ 60                                                             1803270
  65 DTIME=STØP-TIME                                                     1803280
     DELTA=0.0                                                           1803290
     GØTØ 67                                                             1803300
  75 NCYC=NCYC+1                                                         1803310
     MAGIN=-1                                                            1803320
     GØTØ 60                                                             1803340
  25 PHI=TIME                                                            1803350
     IF(KMAG.EQ.4.AND. KSWICH.EQ.1)GØ TØ 26                              1803360
     GØ TØ 27                                                            1803370
  26 READ(1)(TMPAV(I),I=1,5)                                             1803380
  27 CØNTINUE                                                            1803390
     ARG=PHI                                                             1803400
     LL=NP+1                                                             1803410
     DØ 51 I=1,NP                                                        1803420
     IF(ARG-ST(1,I)) 52,55,51                                            1803430
  52 IF(I-1) 55,55,54                                                    1803440
  51 CØNTINUE                                                            1803450
     I=NP                                                                1803460
     GØ TØ 55                                                            1803470
  54 DØ 57 IK=2,NTØTAL                                                   1803480
  57 ST(IK,LL)=ST(IK,I-1)+(ST(IK,I)-ST(IK,I-1))*(ARG-ST(1,I-1))/(ST(1,I 1803490
    1)-ST(1,I-1))                                                        1803500
     GØTØ 80                                                             1803510
  55 DØ 58 IK=2,NTØTAL                                                   1803520
  58 ST(IK,LL)=ST(IK,I)                                                  1803530
  80 CØNTINUE                                                            1803540
C    THE UPDATED INTERPØLATED VALUES ØF THE MATERIAL PRØPERTY CØEFFIC    1803550
C    IENTS ARE FØUND IN THE XMAT TABLE AND STØRED IN THE XLAYER ARRAY    1803560
     L=(MAT-1)*2+1                                                       1803570
     II=NXMAT(L)                                                         1803580
      III=NXMAT(L+1)                                                     1803590
     LL=NP+1                                                             1803600
     L=NRØW + 1                                                          1803610
     IF(KELVIN .NE. 1)GØ TØ 81                                           1803620
     IF(THICK.NE.1)GØ TØ 83                                              1803630
  81 LØØP=1                                                              1803640
     ILØW=1                                                              1803650
     IHIGH = 1                                                           1803660
     IF(KELVIN .NE. 1)GØ TØ 85                                           1803670
  82 IF(                 KSWICH .EQ. 1)GØ TØ 85                          1803680
     TMPAV(ILØW)=(ST(L,LL)+ ST(L+1,LL)+ ST(L+2,LL) + ST(L+3,LL))/4.0     1803690
     GØ TØ 85                                                            1803700
  83 LØØP = 2                                                            1803710
     ILØW= 1                                                             1803720
     IHIGH = 2                                                           1803730
     IF(                 KSWICH .EQ. 1)GØ TØ 85                          1803740
     TMPAV(ILØW)= (ST(L,LL)+ ST(L+1,LL))/2.0                             1803750
     TMPAV(IHIGH)=(ST(L+2,LL) + ST(L+3,LL))/2.0                          1803760
  85 DØ 105 IL=ILØW,IHIGH                                                1803770
     M = 1                                                               1803780
     GØTØ (91,92,93,93),KELVIN                                           1803790
  91 ARG= TMPAV(IL)                                                      1803800
     GØTØ 94                                                             1803810
  93 ARG =TMPAV(1)                                                       1803820
     IF(KSWICH.EQ. 1)GØ TØ 94                                            1803830
     ARG = ST(NRØW+1,LL)                                                 1803840
     TMPAV(1) = ARG                                                      1803850
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 94 DØ 104 I = 2,10
    IF (ARG-XMAT(II,I)) 121,123,104
121 IF (I-2) 8007,8007,124
104 CØNTINUE
    GØTØ 8067
123 L=II+1
    DØ 122 J=L,III
    XLAYER(M)=XMAT(J,I)
122 M=M+1
    GØTØ 111
124 L=II+1
    DØ 125 J=L,III
    XLAYER(M)=XMAT(J,I-1)+(XMAT(J,I)-XMAT(J,I-1))*(ARG-XMAT(II,I-1))/
   1          (XMAT(II,I)-XMAT(II,I-1))
125 M=M+1
    GØTØ 111
 92 L = II + 1
    DØ 922  J=L,III
    XLAYER(M)= XMAT(J,1)
922 M=M+1
111 GØ TØ (115,115,112,113,114),LØØP
112 XNUTP= XLAYER(2)
    IF(ITYPE.NE. 1)GØ TØ 131
    XNUPT= XNUTP
    XGPT(1) = ETHET(1)/(2*(1+ XNUPT) )
    XGPT(2) = ETHET(2)/(2*(1+ XNUPT) )
    GØ TØ 106
131 XNUTP = XLAYER(3)
    XNUPT = ETHET(1)*XNUTP/EPHI(1)
    GØ TØ 106
113 ES= XLAYER(8)
    ALPHS=XLAYER(10)
    GØ TØ 106
114 ALPHR = XLAYER(9)
    ER = XLAYER(7)
    GØ TØ 118
115 GØ TØ(101,102,103),ITYPE
101 ETHET(IL)= XLAYER(1)
    XNUTP     =XLAYER(2)
    ALPHTH(IL)= XLAYER(3)
    EPHI(IL) = ETHET(IL)
    XNUPT= XNUTP
    ALPHPH(IL)= ALPHTH(IL)
    XGPT(IL)= ETHET(IL)/(2.0*(1.0+ XNUPT))
    GØ TØ 105
102 ETHET(IL)= XLAYER(1)
    EPHI(IL) = XLAYER(2)
    XNUTP = XLAYER(3)
    ALPHTH(IL)= XLAYER(4)
    ALPHPH(IL)= XLAYER(5)
    XGPT(IL) = XLAYER(6)
    XNUPT= ETHET(IL)* XNUTP/EPHI(IL)
    GØ TØ 105
103 ETHET(IL)= XLAYER(1)
    EPHI(IL)= XLAYER(2)
    XNUTP= XLAYER(3)
    ALPHTH(IL) = XLAYER(4)
    ALPHPH(IL) = XLAYER(5)
    XGPT(IL) = XLAYER(6)
    ER= XLAYER(7)
    ES =XLAYER(8)
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      ALPHR = XLAYER(9)
      ALPHS = XLAYER(10)
      XNUPT = ETHET(IL) * XNUTP/EPHI(IL)
  105 CØNTINUE
  106 L = NRØW+1
      GØ TØ (117,107,108,281,118),LØØP
  107 LØØP= 3
      ILØW = 3
      IHIGH= 3
      GØ TØ 82
  108 IF(ITYPE .EQ.3 .AND. ISTTAB .GE. 3)GØ TØ 109
      GØ TØ 116
  109 LØØP= 4
      ILØW =4
      IHIGH = 4
      IF(                 KSWICH .EQ. 1 )GØ TØ 85
      CPH = ST(3,LL)
      IF(ISTTAB.GE. 10.AND. ISTTAB.LE. 12)CPH = ST(6,LL)
      IF(CPH      .LE.0)GØ TØ 284
      TMPAV(4)= ST(L,LL)
      GØ TØ 85
  284 TMPAV(4) =ST(L+3,LL)
      GØ TØ 85
  281 LØØP=5
      ILØW=5
      IHIGH=5
      IF(                   KSWICH .EQ. 1)GØ TØ 85
      CTH = ST(3,LL)
      IF(ISTTAB .GE. 10 .AND. ISTTAB .LE. 12)CTH = ST(7,LL)
      IF(CTH      .LE. 0)GØ TØ 116
      TMPAV(5)= ST(L,LL)
      GØ TØ 85
  116 TMPAV(5)= ST(L+3,LL)
      GØ TØ 85
  117 CØNTINUE
      ETHET(2)= ETHET(1)
      ALPHTH(2)=ALPHTH(1)
      ALPHPH(2)=ALPHPH(1)
      XGPT(2)= XGPT(1)
      EPHI(2)= EPHI(1)
  118 CØNTINUE
      CALL TØBAR (ST,KLUE2,NRØW,LL,ER,ES,ZINTH,ZØUTTH,E1,E2,
     A  ZINPH,ZØUTPH,HI,HØ,T,TII,TØØ,TIK,TØK,DEGRES,
     1  G2,G3,TIME,NTØTAL)
      IF (NIX.NE.0) GØ TØ 9999
C     CØMPUTATIØN ØF K AND D FØR K AND D INPUT
      LL=NP+1
      IF(XK11.EQ.0.0) GØTØ 8101
      IF(ITYPE.EQ.3.AND.XK12.EQ.0.) GØ TØ 8102
      IF(ITYPE.EQ.3.AND.XK21.EQ.0.) GØ TØ 8103
      IF(XK22.EQ.0.0) GØTØ 8104
      IF(XK33.EQ.0.0) GØTØ 8105
      IF(XD11.EQ.0.0) GØTØ 8106
      IF(ITYPE.EQ.3.AND.XD12.EQ.0.) GØ TØ 8107
      IF(ITYPE.EQ.3.AND.XD21.EQ.0.) GØ TØ 8108
      IF(XD22.EQ.0.0) GØTØ 8109
      IF(XD33.EQ.0.0) GØTØ 8110
      NL=0
      XNPHI = 0.0
      IJKLMN=NRØW+LST(1)+LST(2)+LST(3)+LST(4)+LST(5)+LST(6)+1
      IF(XNL.NE.0.0) XNPHI = ST(IJKLMN,LL)
```

```
      JF = NPRØB
      K = NRØW
      DØ 77 M=1, JF
      I = (M-1)*8 + 1
      NL=NL+1
      XFTHLD=0.0
      XFPHLD=0.0
      XFZELD=0.0
      XMTHLD=0.0
      XMPHLD=0.0
      IR=NL*6-5
      IF(LST(IR).NE.0) K=K+LST(IR)
      IF (LST(IR+1).EQ.0) GØTØ 44
      K=K+1
      XFTHLD=ST(K,LL)
   44 IF(LST(IR+2).EQ.0) GØTØ 45
      K=K+1
      XFPHLD=ST(K,LL)
   45 IF(LST(IR+3).EQ.0) GØTØ 46
      K=K+1
      XFZELD=ST(K,LL)
   46 IF(LST(IR+4).EQ.0) GØTØ 47
      K=K+1
      XMTHLD=ST(K,LL)
   47 IF(LST(IR+5).EQ.0) GØTØ 48
      K=K+1
      XMPHLD=ST(K,LL)
   48 CØNTINUE
      IF (ISTTAB.GE.3.AND.ISTTAB.LE.9) GØ TØ 4002
      CALL ØDE1
      GØ TØ 77
 4002 CALL ØDE2
   77 CØNTINUE
      GØTØ 75
 8001 IERRØR=8001
      NERRØR = 11
      GØTØ 8888
 8002 IERRØR=8002
      NERRØR = 12
      GØTØ 8888
 8007 IERRØR=8007
      NERRØR = 15
      GØTØ 8888
 8008 IERRØR = 8008
      NERRØR = 10
      GØ TØ 8888
 8009 IERRØR = 8009
      NERRØR = 8
      GØ TØ 8888
 8031 IERRØR=8031
      NERRØR = 9
      GØTØ 8888
 8036 IERRØR=8036
      NERRØR = 2
      GØTØ 8888
 8086 IERRØR=8086
      NERRØR = 3
      GØTØ 8888
 8087 IERRØR=8087
      NERRØR = 4
      GØTØ 8888
```

```
8088 IERRØR=8088
     NERRØR = 27
     GØTØ 8888
8089 IERRØR=8089
     NERRØR = 5
     GØTØ 8888
8090 IERRØR=8090
     NERRØR = 6
     GØTØ 8888
8067 IERRØR= 8067
     NERRØR = 16
     GØTØ 8888
8101 IERRØR = 8101
     NERRØR = 17
     GØTØ 8888
8102 IERRØR = 8102
     NERRØR = 18
     GØTØ 8888
8103 IERRØR = 8103
     NERRØR = 19
     GØTØ 8888
8104 IERRØR = 8104
     NERRØR = 20
     GØTØ 8888
8105 IERRØR = 8105
     NERRØR = 21
     GØTØ 8888
8106 IERRØR = 8106
     NERRØR = 22
     GØTØ 8888
8107 IERRØR = 8107
     NERRØR = 23
     GØTØ 8888
8108 IERRØR = 8108
     NERRØR = 24
     GØTØ 8888
8109 IERRØR = 8109
     NERRØR = 25
     GØTØ 8888
8110 IERRØR = 8110
     NERRØR = 26
     GØTØ 8888
8013 IERRØR=8013
     NERRØR = 7
     GØTØ 8888
8501 IERRØR = 8501
     NERRØR = 35
     GØ TØ 8888
C     THE HUBER VØN MISSES STRESS EQUATIØNS
 110 CALL ØUTPUT        (KLUE,YCØRR,ER,ES,ALPHR,ALPHS,ZINTH,
    1       ZØUTTH,ZINPH,ZØUTPH,NCYC,TIME,DEGRES,DTA,STEP,
    2 HI,HØ,T,TII,TØØ,THK,TIK,TØK,RØ2,E1,E2  )
     IF(NIX.EQ.1) GØ TØ 9999
     GØ TØ 6450
8888 NIX=1
     GØ TØ 9999
 150 IF (NHAR.EQ.NHRC.AND.NGRAPH.NE.0) CALL GRAPH (NPRØB)
     IF (IPR.EQ.0.ØR.NHRC.EQ.NHAR) GØ TØ 9997
     WRITE(6,7001)TIME,DEGRES ,DTA,STEP,RØ,THK,YCØRR(5),YASAVE(6),
    1YASAVE(8),YCØRR(3), YCØRR(1),XNTTH,YCØRR(6),YASAVE(7),YASAVE(1),
    2YCØRR(2),YASAVE(4),XNTPH,YCØRR(7),YCØRR(8),YASAVE(2),
```

```
    3 YCØRR(4),YASAVE(3),XMTTH                                         1806300
      WRITE(6,7012)YASAVE(5),XMTPH                                     1806310
 7012 FØRMAT(24X,E14.7,70X,E14.7,///)                                  1806320
 7001 FØRMAT((3X,6(E14.7,7X)))                                         1806330
 9997 IF(LSC .LT. KSC)GØ TØ 902                                        1806340
 9999 RETURN                                                           1806350
      END                                                              1806360
```

```
FØR,IS FIXEM,FIXEM
      SUBRØUTINE FIXEM (MAGIN,MAGØUT,TIC,STEP,NEQNS,DTAU,
     1                    EPSIL,DELTA,ERR,TIME,DTIME,YICS,YPRED,
     2 YCØRR,YDØT,YNEW,YDEV,FWDEL,TBDEL,K)
C     RUNGE KUTTA MAGIC (REVISED)  SINGLE PRECISIØN         FØRTRAN IV   1900060
      DIMENSIØN YICS( 1),YPRED( 1),YCØRR( 1), YDØT( 1), YNEW( 1),        1900070
     1           YDEV(1),FWDEL(1),TBDEL(1)
      DIMENSIØN C(3),D(3)                                                1900100
      DØUBLE PRECISIØN YNEW,YPRED                                        1900110
      DATA C,D / .5,.5,1.0,.5,.0,.5/                                     1900120
      MSET=1                                                             1900130
      TIME = TIC                                                         1900140
      TAU  = TIC                                                         1900150
      IF (DELTA)200,201,200                                              1900160
  200 DTIME = 0.0078125                                                  1900170
      GØ TØ 225                                                          1900180
  201 DTIME = STEP                                                       1900190
  225 DØ 102 I = 1,NEQNS                                                 1900200
      YDEV(I)  = 0.0                                                     1900210
      YPRED(I) = YICS(I)                                                 1900220
      YCØRR(I) = YICS(I)                                                 1900230
  102 YNEW(I)  = YICS(I)                                                 1900240
      MAGØUT   =-2                                                       1900250
      GØ TØ 264                                                          1900260
 5555 CØNTINUE                                                           1900270
      ENTRY WAND(MAGIN,MAGØUT,TIC,STEP,NEQNS,DTAU,EPSIL,DELTA,ERR,
     1TIME,DTIME,YICS,YPRED,YCØRR,YDØT,YNEW,YDEV,FWDEL,TBDEL,K)
 5556 CØNTINUE                                                           1900290
      IF (MAGØUT) 305,101,101                                            1900310
  101 IF(MAGIN) 21, 27, 14                                               1900320
   27 K = 0                                                              1900330
      DØ 202 I = 1,NEQNS                                                 1900340
  202 YNEW(I)  = YPRED(I)                                                1900350
   21 K = K +1                                                           1900360
      DØ 2 I=1,NEQNS
      GØ TØ (9,6,7,4,11),K                                               1900380
    9 FWDEL(I) = YDØT(I)                                                 1900390
      GØ TØ 105                                                          1900400
    6 TBDEL(I) = YDØT(I)                                                 1900410
      GØ TØ 105                                                          1900420
    7 TBDEL(I) = TBDEL(I) + YDØT(I)                                      1900430
  105 YPRED(I) = YNEW(I) + C(K)*DTIME*YDØT(I)                            1900440
      GØ TØ (2,2,400),K                                                  1900450
  400 YCØRR(I) = YPRED(I)                                                1900460
    2 CØNTINUE                                                           1900470
      TIME     = TIME + D(K)*DTIME                                       1900480
   99 MAGØUT   = 0.0                                                     1900490
  264 RETURN                                                             1900500
    4 DØ  8  I = 1,NEQNS                                                 1900510
      YPRED(I) = YNEW(I) + DTIME*(FWDEL(I) + 2.*TBDEL(I) + YDØT(I))/6.   1900520
    8 YDEV(I)  = YCØRR(I) - YPRED(I)                                     1900530
      GØ TØ 99                                                           1900540
   11 IF (DELTA)80, 5,80                                                 1900550
   80 DØ  13 I = 1,NEQNS                                                 1900560
      IF (EPSIL*ABS(YCØRR(I)) + ERR - ABS(YDEV(I))) 14,13,13             1900570
   13 CØNTINUE                                                           1900580
      IF (SIGB)15,15,205                                                 1900590
  205 SIGB = 0.0                                                         1900600
      GØ TØ 5                                                            1900610
   15 SIGB = 0.0                                                         1900620
      DØ 207 I = 1,NEQNS                                                 1900630
```

```
      IF (ERR  /100.+ DELTA*ABS(YCØRR(I)) - ABS(YDEV(I))) 5,207,207      1900640
  207 CØNTINUE                                                           1900650
      DTIME     = 2.*DTIME                                               1900660
    5 DØ 208 I = 1,NEQNS                                                 1900670
  208 YCØRR(I) = YPRED(I)                                                1900680
  305 IF (DTAU) 19,30,19                                                 1900690
   19 IF (TAU - TIME)20,20,27                                            1900700
   20 TAU = TAU + DTAU                                                   1900710
   30 MAGØUT = 2                                                         1900720
      GØ TØ 264                                                          1900730
   14 DTIME = DTIME/2.0                                                  1900740
      IF (K-3) 48,26,26
   26 TIME  = TIME - DTIME - DTIME                                       1900760
      GØ TØ 47                                                           1900770
   48 TIME  = TIME - DTIME                                               1900780
   47 SIGB      = +2.                                                    1900790
      DØ 209 I = 1,NEQNS                                                 1900800
  209 YDØT(I) = FWDEL(I)                                                 1900810
  212 K         = 0                                                      1900820
      GØ TØ 21                                                           1900830
       END                                                               1900840
```

```
FØR,IS TØBAR,TØBAR
      SUBRØUTINE TØBAR (ST,KLUE2,NRØW,LL,ER,ES,ZINTH,ZØUTTH,E1,
     A E2, ZINPH,ZØUTPH,HI,HØ,T,TII,TØØ,TIK,TØK,DEGRES,                 2600020
     B G2,G3,TIME,NTØTAL)
      INTEGER SAVJTC,SAVSTP,Q,THICK
      REAL*4 I2
      CØMMØN STØRY(16),TALE(16),XMAT(110,10),STD(10),SADUS(30),RADUS(30) 2600060
      CØMMØN TADUS(30),UADUS(30),SAVTIC(900)                            2600070
      CØMMØN XN,TEFREE,TIC,PHI,STØP,RESTØP,RTICK,G1,XNL                 2600080
      CØMMØN NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)  2600090
      CØMMØN JRSTØP(30),NREG,NSEGTL,NMPT,MATPRP,NCUPLE,NRGEND,NSYM,NRG  2600100
      CØMMØN NRC,NSC,NIX,IERRØR,IØUT,MAT,KGEØM,IGEØM,ITYPE,ISTTAB,KELVIN 2600110
      CØMMØN IBEGIN,NPRØB,NHARM,NSEG,NERRØR,Q,NSMAX,THICK               2600120
      CØMMØN /LASTEQ/ YPRED( 80),YDØT( 80),YASAVE( 80),                 2600130
     1                YANTH,YAMTH,YAMPT,YANPT,YAØPH,YAQPH,YAQTH,YAJPH,  2600140
     2                S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,        2600150
     3                X1RØ,X1RØSQ,X1SNRØ,X1CSRØ,CN1RØ,SN1RØ,CS1RØ,      2600160
     4                X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RØ,BESQ,  2600170
     5    RØSQ,XNSQ,BETA,R1,R2,S1,R1DØT,R1SQ,                           2600180
     6                XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,     2600190
     7  XMTHLD,XMPHLD,ETHET(2),EPHI(2),XGPT(2),ALPHTH(2),ALPHPH(2),     2600200
     8                XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,   2600210
     9                XK11,XK12,XK21,XK22,XK33,XD11,                    2600220
     A                   M,I,SITIN,SITØUT,SIPIN,SIPØUT,TPTIN,TPTØUT,    2600230
     B              ZBRIN,ZBRØUT,SCRIPA,SCRIPI,SIFIN,SIFØUT,TZEPH,TZETH , 2600240
     C       XNPHI,BETTA,XC16,XC14,XC25                                 2600250
      CØMMØN /SNILPS/ ANG,PSI(100),RAD(100),CUR1(100),CUR2(100),        2600260
     1       DR1DP(100),ZI(14),RI(14),NRZIN                             2600270
      DATA A/-A    -/                                                   2600280
      DOUBLE PRECISIØN YPRED                                            2600290
      DIMENSIØN ST(72,31)                                               2600300
      GØTØ (771,772,773,774,775,776,7077),KGEØM                         2600310
C     GEØMETRY FØR ELIPSE(G3=ØFFSET DISTANCE )                          2600320
  771 A=G1                                                              2600330
      BE=G2                                                             2600340
      BETA = BE                                                         2600350
       BESQ=BE**2                                                       2600360
      ASQ=A**2                                                          2600370
      SN=SIN(PHI)                                                       2600380
      CS=CØS(PHI)                                                       2600390
      SNSQ = SN**2                                                      2600400
      CSSQ = CS**2                                                      2600410
      R2 = A*SQRT(1.0/(SNSQ+BESQ*CSSQ))                                 2600420
      R2SQ = R2**2                                                      2600430
      RØ=R2*SN                                                          2600440
      R1=R2*R2SQ*BESQ/ASQ                                               2600450
      BESQ=BE**2                                                        2600460
      R1DØT=0.0                                                         2600470
      IF(KGEØM.EQ.1.AND.BETA.NE.1.0.AND.SN.NE.0.0)R1DØT=3.0*(R2*BETA/   2600480
     1A) **2*(CS/SNSQ)*(R1*SN-RØ)                                       2600490
      IF (SN) 679,779,679
  679 R2 = R2-G3/SN
      R2SQ = R2**2                                                      2600520
      RØ = RØ-G3                                                        2600530
      GØ TØ 7775                                                        2600540
  779 IF (G3) 678,7775,678
  678 R1DØT = 3.0*G3
      RØ = -G3                                                          2600570
      GØ TØ 7775                                                        2600580
C     GEØMETRY FØR ØGIVE                                                2600590
  772 R1=G1                                                             2600600
```

```
      C=G2                                                              2600610
      SN=SIN(PHI)                                                       2600620
      CS=CØS(PHI)                                                       2600630
      IF (SN) 680,777,680
  680 R2 = R1-C/SN
      GØTØ 778                                                          2600660
  777 R2 = 1.0                                                          2600670
  778 RØ = R1*SN-C                                                      2600680
      R1DØT=0.0                                                         2600690
      GØTØ 7775                                                         2600700
C     GEØMETRY FØR CØNE                                                 2600710
  773 CS = CØS(G1)                                                      2600720
      SN=SIN(G1)                                                        2600730
      S=PHI                                                             2600740
      S1=1.0/S                                                          2600750
      R2=CS*SN*PHI                                                      2600760
      RØ=PHI*CS                                                         2600770
      R1DØT=0.0                                                         2600780
      GØTØ 7775                                                         2600790
C     GEØMETRY FØR CYLINDER                                             2600800
  774 RØ = G1                                                           2600810
      SN=1.0                                                            2600820
      CS=1.0                                                            2600830
      R1DØT=0.0                                                         2600840
      GØTØ 7775                                                         2600850
C   MØDIFIED  ELLIPSE                                                   2600860
  775 XNEXP=G1                                                          2600870
      A   =G2                                                           2600880
      XN1=1.0+XNEXP                                                     2600890

      XN2=1.0/XN1                                                       2600900
      XN3=XN1+1.0                                                       2600910
      XN4=XN3+1.0                                                       2600920
      XN5=XN4/XN1                                                       2600930
      SN = SIN(PHI)                                                     2600940
      CS = CØS(PHI)                                                     2600950
      R2= A*(2.0/(1.0+SN**XN1))**XN2                                    2600960
      R1=(A/2.0)*(R2/A)**XN3                                            2600970
      RØ=R2*SN                                                          2600980
      R1DØT=-XN3*A*(SN**XNEXP*CS/4.0)*(2.0/(1.0+SN**XN1))**XN5          2600990
      GØTØ 7775                                                         2601000
C     GENERAL GEØMETRY                                                  2601010
  776 SN=SIN(PHI)                                                       2601020
      CS=CØS(PHI)                                                       2601030
      TAN = SN / CS                                                     2601040
      SEC = 1.0 / CS                                                    2601050
      IF (TIME.EQ.TIC) CALL TEMØEG                                      2601060
      ARG = PHI                                                         2601070
      DØ 204 J=1,100                                                    2601080
      PHØ = PSI(J)                                                      2601090
      IF (ANG.EQ.A) IF (ARG-PHØ) 221,223,204                            2601100
      IF (PHØ-ARG) 221,223,204                                          2601110
  221 IF (J-1) 8502,8502,224                                            2601120
  204 CØNTINUE                                                          2601130
      GØ TØ 8503                                                        2601140
  223 RØ = RAD(J)                                                       2601150
      R1 = CUR1(J)                                                      2601160
      R2 = CUR2(J)                                                      2601170
      R1DØT = DR1DP(J)                                                  2601180
      GØ TØ 7775                                                        2601190
 8502 NERRØR = 43                                                       2601200
```

```
      GØ TØ 8888
 8503 NERRØR = 44
 8883 NIX = 1
      GØ TØ 8889
  224 SUB1 = ARG-PSI(J-1)
      SUB2 = PSI(J)-PSI(J-1)
      RØ = RAD(J-1)+(RAD(J)-RAD(J-1))*SUB1/SUB2
      R1 = CUR1(J-1)+(CUR1(J)-CUR1(J-1))*SUB1/SUB2
      R2 = CUR2(J-1)+(CUR2(J)-CUR2(J-1))*SUB1/SUB2
      R1DØT = DR1DP(J-1)+(DR1DP(J)-DR1DP(J-1))*SUB1/SUB2
      GØTØ 7775
C     ISØTENSØID GEØMETRY
 7077 CØNTINUE
      SN = SIN(PHI)
      CS = CØS(PHI)
      A  = G1
      R2 = A / SQRT(SN)
      R1 = 0.5 * R2
      RØ = R2 * SN
      R1DØT = - ((A**2)*0.5)*(R1*CS)/RØ**2
 7775 TAN=SN/CS
      DEGRES  = 0.0
      IF(IGEØM.EQ.1) DEGRES = PHI * 57.29578
      RØSQ = RØ**2
      XNSQ=XN**2
      CN=CS*SN
      X1CS=1.0/CS
      TN=SN/CS
      X1RØ=1.0/RØ
      X1RØSQ=1.0/RØ**2
      X1CSRØ=1.0/(CS*RØ)
      CN1RØ=CN/RØ
      SN1RØ=SN/RØ
      CS1RØ=CS/RØ
      SNSQ=SN**2
      CSSQ=CS**2
      IF(KGEØM.EQ.4.ØR.KGEØM.EQ.3) GØTØ 79
      R1SQ = R1**2
      R2SQ = R2**2
      X1SN=1.0/SN
      X1SNRØ=1.0/(SN*RØ)
      X1R1=1.0/R1
      X1R2=1.0/R2
      CS1R1=CS/R1
      CS1R2=CS/R2
      SN1R1=SN/R1
      X1R1SQ=1.0/R1**2
   79 XNTTH=0.0
      XNTPH=0.0
      XMTTH=0.0
      XMTPH=0.0
      IF (ISTTAB.LE.3) GØ TØ 710
  740 IF(ISTTAB.LT.10)GØ TØ 738
  737 K=NTØTAL-3
      ZINTH = ST(K,LL)
      ZØUTTH= ST(K+1,LL)
      ZINPH = ST(K+2,LL)
      ZØUTPH= ST(K+3,LL)
      GØ TØ 710
  738 K=NTØTAL-1
      ZINTH  = ST(K,LL)
```

```
      ZØUTTH = ST(K+1,LL)
      ZINPH  = ZINTH
      ZØUTPH = ZØUTTH
  710 CØNTINUE
C
C     CØMPUTATIØN ØF K AND D FØR MATERIAL PRØPETY INPUT
C
C
      GØ TØ (711,600,711,32,33,34,32,33,34,28,29,30 ),ISTTAB
C     THICK
  600 GØ TØ (703,702,701,701),THICK
  701 HØ= ST(4,LL)
  702 T = ST(3,LL)
  703 HI= ST(2,LL)
      GØ TØ 40
C     ST11,ST12,ST13
   30 HØ= ST(14,LL)
   29 T = ST(13,LL)
   28 HI= ST(12,LL)
      GJPH= ST(2,LL)
      GJTH= ST(3,LL)
      APH = ST(4,LL)
      ATH = ST(5,LL)
      CPH = ST(6,LL)
      CTH = ST(7,LL)
      XIPH = ST(8,LL)
      XITH= ST(9,LL)
      SPH = ST(10,LL)
      STH = ST(11,LL)
      GØ TØ 40
C     RWAF1,RWAF2,RWAF3, AND ISG1,ISG2,ISG3
   34 HØ=ST(9,LL)
   33 T =ST(8,LL)
   32 HI=ST(7,LL)
      APH = ST(2,LL)
      CPH = ST(3,LL)
      XIPH= ST(4,LL)
      SPH = ST(5,LL)
      HETTA=ST(6,LL)
      ATH = APH
      CTH = CPH
      XITH= XIPH
      STH = SPH
      XC16 = 0.
      GØ TØ 40
C     ST10,RWAF
C     RANKIN=THSTND MEANS INTERPØLATE,CØMPUTE NTEMP,MTEMP
C     RANKIN=NØTHRM MEANS DØ NØT INTERPØLATE,DØ NØT CØMPUTE NTEMP,NTEMP
C     RANKIN=THCNST MEANS DØ NØT AVERAGE, BUT INTERPØLATE,CØMPUTE
C                                                   NTEMP, MTEMP
C     RANKIN=THINHØ MEANS INTERPØLATE,BUT DØ NØT CØMPUTE NTEMP,MTEMP
C
  711 CØNTINUE
      XK11=ST(2,LL)
      XK12=ST(3,LL)
      XK22 = ST(4,LL)
      XK33 = ST(5,LL)
      XD11 = ST(6,LL)
      XD12 = ST(7,LL)
      XD22 = ST(8,LL)
      XD33 = ST(9,LL)
```

```
      XC11 = ST(10,LL)
      XC22 = ST(11,LL)
      XC15 = ST(12,LL)
      XC16 = ST(13,LL)
      XK21 = XK12
      XD21 = XD12
      GØ TØ 103
C
   40 CØNTINUE
      TEMP3= (1.0-XNUPT * XNUTP)
      PERM= TEMP3
      E1= (ETHET(1)+ EPHI(1))/2.
      E2= (ETHET(2)+ EPHI(2))/2.
      ES1= E1+E2
      GØ TØ (42,47,49,41),THICK
   41 GØ TØ (103,42,103,42,47,49,42,47,49,42,47,49),ISTTAB
C
C     SINGLE SHEET
C
   42 TEMP1= ETHET(1) * HI
      TEMP2= TEMP1 * HI**2
      XK11= TEMP1/TEMP3
      XD11= TEMP2/(12.0* TEMP3)
      TEMP1= EPHI(1)* HI
      TEMP2= TEMP1*HI**2
      XK22= TEMP1/TEMP3
      XD22= TEMP2/(12.0* TEMP3)
      XK33= XGPT(1)* HI
      XD33= XK33*HI**2/12.0
      GØ TØ 55
C
C     EQUAL SHEETS
C
   47 EPSUM= EPHI(1)+ EPHI(2)
      ETSUM= ETHET(1)+ ETHET(2)
      XK11= ETSUM * HI/PERM
      XK22= EPSUM * HI/PERM
      XK33= HI*(XGPT(1)+ XGPT(2))
      ZBRIN = (HI*(E1+3.0*E2)+2.0*E2*T)/(2.0*ES1)
      ZBRØUT = (HI*(E2+3.0*E1)+2.0*E1*T)/(2.0*ES1)
      ZBHIN= (ZBRIN- HI/2.0)**2
      ZBHØUT=(ZBRØUT-HI/2.0)**2
      XD33= (HI**3*(XGPT(1)+XGPT(2)))/12.0+ HI*(XGPT(1)* ZBHIN
     1     +  XGPT(2)* ZBHØUT)
      XD11=(XK11* HI**2)/12.+ HI*( ETHET(1) * ZBHIN + ETHET(2)*ZBHØUT)
     1/PERM
      XD22=(XK22* HI**2)/12.+ HI*( EPHI(1) * ZBHIN + EPHI(2)* ZBHØUT)
     1/PERM
      GØ TØ 55
C
C     UNEQUAL FACE SHEETS
C
   49 CØNTINUE
      ZBRIN =((E1*HI**2)+(E2*HØ**2) +(2.0*E2*HØ*HI) +(2.0*E2*HØ*T)) /
     1 (2.0*(E1*HI+E2*HØ))
      ZBRØUT=((E1*HI**2)+(E2*HØ**2) +(2.0*E1*HØ*HI) +(2.0*E1*HI*T)) /
     1 (2.0*(E1*HI+E2*HØ))
      ZBHIN =(ZBRIN-HI/2.0)**2
      ZBHØUT =(ZBRØUT-HØ/2.0)**2
      XK11= (ETHET(1)* HI + ETHET(2)* HØ)/PERM
      XK22= (EPHI(1) * HI + EPHI(2) * HØ)/PERM
```

```
      XK33= XGPT(1)*HI + XGPT(2) * HØ                                   2603040
      XD33 = (XGPT(1)*HI**3+XGPT(2)*HØ**3)/12.+HI*(XGPT(1)*ZBHIN)+      2603050
     1 XGPT(2)*ZBHØUT*HØ                                                2603060
      D11 =  (ETHET(1)*HI**3 + ETHET(2)*HØ**3)/12.                      2603070
      XD11=(D11+ (HI*ETHET(1)*ZBHIN)   + (HØ*ETHET(2)*ZBHØUT))/PERM     2603080
      D22 =  (EPHI(1)* HI**3 + EPHI(2)*HØ**3)/12.                       2603090
      XD22= ( D22 +(HI*EPHI(1)*ZBHIN) + (HØ*EPHI(2)* ZBHØUT)) /PERM     2603100
C                                                                       2603110
C     DETERMINE CØMPLETE CØNSTANTS DEPENDENT ØN REINFØRCEMENT CLUE      2603120
C                                                                       2603130
   55 CØNTINUE                                                          2603140
      IF(ISTTAB .EQ.2)GØ TØ 103                                         2603150
      EASTH=ER*ATH/STH                                                  2603160
      EASPH=ES*APH/SPH                                                  2603170
      EISPH= ES* XIPH/SPH                                               2603180
      EISTH= ER* XITH/STH                                               2603190
      GØ TØ (58,60,100),KLUE2                                           2603200
C                                                                       2603210
C     ST CLUE(10,11,12)                                                 2603220
C                                                                       2603230
   58 CØNTINUE                                                          2603240
      XK12= XK11*XNUTP                                                  2603250
      XK11= XK11+ EASTH                                                 2603260
      XK22= XK22+ EASPH                                                 2603270
      XC11= EASTH*CTH                                                   2603280
      XC22= EASPH*CPH                                                   2603290
      XD22 = -XD22-EISPH                                                2603300
      XD33= XD33 + GJPH/(4.0*SPH)+ GJTH/(4.0*STH)                       2603310
      XD12= -XD11*XNUTP                                                 2603320
      XD11= -XD11- EISTH                                                2603330
      XK21 = XK12                                                       2603340
      XD21 = XD12                                                       2603350
      GØ TØ 103                                                         2603360
C     RAF CLUE(1,2,3)                                                   2603370
C                                                                       2603380
   60 CØNTINUE                                                          2603390
      SINB =SIN(BETTA)                                                  2603400
      CØSB =CØS(BETTA)                                                  2603410
      SN2TØ4 = 2*(SINB**4.)                                             2603420
      D= STH*(CØSB+SINB)                                                2603430
      ED = ER*ATH/D                                                     2603440
      SINB2= SINB**2.                                                   2603450
      ZBAR= ZINTH                                                       2603460
      IF(CTH.GT. 0.)GØ TØ 64                                            2603470
      ZBAR= ZØUTTH                                                      2603480
   64 CØNTINUE                                                          2603490
      IF(ZBAR.GT.0)GØ TØ 65                                             2603510
      ZBAR=-ZBAR                                                        2603520
   65 IF(CTH.GT.0.)GØ TØ 91                                             2603530
      CTHABS=-CTH                                                       2603540
      GØ TØ 92                                                          2603550
   91 CTHABS=CTH                                                        2603560
   92 HL= 2*( ZBAR -CTHABS)                                             2603570
      I2=(ATH**3.)/(3* HL**2)                                           2603580
      XC22 = 2.0*CTH*CØSB**3*ED
      XC15 = 2.0*CTH*CØSB*SINB2*ED                                      2603660
      XC16 = XC15                                                       2603670
      GRI=  ER* I2/(2.0*(1.0 + XNUTP)*D)                                2603680
      XC11 = CTH*SN2TØ4/CØSB*ED
      EDI = ER*XITH/D                                                   2603710
      SN4TØ2 = 4.*SINB2                                                 2603720
```

```
      XD22 = -XD22-2.0*CØSB**3*EDI-SN4TØ2*CØSB*GRI                       2603730
      TB= 2.0* BETTA                                                     2603750
      XD33 = XD33+((4.0*CØS(TB)*                                         2603770
     1*2*GRI)/ CØSB) + (2.0*CØSB*SINB2*EDI)                              2603780
      XD12 = -XD11*XNUTP-(2.0*CØSB                                       2603790
     1*SINB2*EDI)-(SN4TØ2*CØSB*GRI )                                     2603800
      XK12= XK11*XNUTP + (2.0*CØSB*SINB2*ED)                             2603810
      XK22=XK22+(2*CØSB**3*ED)                                           2603820
      XK33=XK33+(2*CØSB*SINB2*ED)                                        2603830
      XK11=XK11+(SN2TØ4*ED/CØSB)                                         2603840
      XD11 = -XD11-SN2TØ4*EDI/CØSB-(                                     2603850
     1 SN4TØ2*CØSB*GRI)                                                  2603860
      XK21 = XK12                                                        2603870
      XD21 = XD12                                                        2603880
      GØ TØ 103                                                          2603890
C                                                                        2603900
C     ISG CLUE(7,8,9)                                                    2603910
C                                                                        2603920
  100 CØNTINUE                                                           2603930
      SNB =SIN(BETTA)                                                    2603940
      CSB =CØS(BETTA)                                                    2603950
      TBETTA= 2.0*BETTA                                                  2603960
      CS2B= CØS(TBETTA)                                                  2603970
      ØNEC2B=(1.0+ CS2B)/2.                                              2603980
      SCB2  =(SNB-CS2B*SNB + 2.)/(2.0*CSB)                               2603990
      SN2B  =SIN(TBETTA) /2.                                             2604000
      XK12=XK11*XNUTP + (EASTH*SNB*ØNEC2B/CSB)                           2604010
      XK11=XK11+ EASTH*SCB2                                              2604020
      XK22=XK22+ EASTH*(CSB/SNB*ØNEC2B)                                  2604030
      XK33=XK33+ EASTH* SN2B                                             2604040
      XC11=      (EASTH*CTH* SCB2 )                                      2604050
      XC15=EASTH*CTH*( SNB* ØNEC2B/CSB )                                 2604060
      XC16=EASTH*CTH*SN2B                                                2604070
      XC22= EASTH*CTH* (CSB/SNB * ØNEC2B)                                2604080
      XD12=-XD11*XNUTP- EISTH*(SNB*ØNEC2B/CSB)                           2604090
      XD11=-XD11- EISTH*SCB2                                             2604100
      XD22 = -XD22-EISTH*(CSB/SNB*ØNEC2B)                                2604110
      XD33= XD33+ EISTH*SN2B                                             2604120
      XK21 = XK12                                                        2604130
      XD21 = XD12                                                        2604140
C                                                                        2604150
C                                                                        2604160
C                                                                        2604170
  103 CØNTINUE                                                           2604180
C                                                                        2604190
      GØTØ (716,714,715,714),KELVIN                                      2604200
  716 TII = ST(NRØW+1,LL)                                                2604210
      TIK = ST(NRØW+2,LL)                                                2604220
      TØK = ST(NRØW+3,LL)                                                2604230
      TØØ = ST(NRØW+4,LL)                                                2604240
      GØTØ 717                                                           2604250
  715 TII = ST(NRØW+1,LL)                                                2604260
      TIK = TII                                                          2604270
      TØK = TII                                                          2604280
      TØØ = TII                                                          2604290
C                                                                        2604300
  717 TEMP11= ALPHTH(1)+ XNUTP * ALPHPH(1)                               2604310
      TEMP12= ALPHTH(2)+ XNUTP * ALPHPH(2)                               2604320
      TEMP21= ALPHPH(1)+ XNUPT * ALPHTH(1)                               2604330
      TEMP22= ALPHPH(2)+ XNUPT * ALPHTH(2)                               2604340
      TEMP3 = 1-XNUPT*XNUTP                                              2604350
```

```
      TEMP4 = HI/4.0
      ETHK1=  ETHET(1)*TEMP11/TEMP3
      TEMP5 = HI**2/24.0
      ETHK2 = ETHET(2)*TEMP12/TEMP3
      TEMP61= TII+ TIK-2* TEFREE
      TEMP62= TØØ+ TØK-2* TEFREE
      TEMP71= 2.0* TII +TIK-3*TEFREE
      TEMP72= 2.0* TØØ +TØK-3*TEFREE
      EPHK1 = EPHI(1)*TEMP21/TEMP3
      EPHK2 = EPHI(2)*TEMP22/TEMP3
      GØ TØ (811,812,813,814),THICK
C
C
  811 XNTTH= ETHK1    *           TEMP4 * (TEMP61+ TEMP62)
      XNTPH= EPHK1    *           TEMP4 * (TEMP61 + TEMP62)
      XMTTH= ETHK1    *           TEMP5 * (TEMP71- TEMP72)
      XMTPH= EPHK1    *           TEMP5 * (TEMP71 - TEMP72)
      GØ TØ 714
  812 TI = (HI*(E2-E1)+2.0*E2*T)/(2.0*(E1+E2))
      TØ = (HI*(E1-E2)+2.0*E1*T)/(2.0*(E1+E2))
      TEMP8= HI/2.0
      XNTTH = ETHK1   *        TEMP8*TEMP61 + ETHK2   *       TEMP8*
     1TEMP62
      XNTPH = EPHK1  *         TEMP8*TEMP61 + EPHK2   *       TEMP8*
     1TEMP62
      XMTTH =(ETHK1 *  TEMP8 * (HI*TEMP71/3.0+ TI*TEMP61)) - (ETHK2 *
     1 TEMP8*(HI*TEMP72/3.0+TØ*TEMP62))
      XMTPH =(EPHK1 *  TEMP8 * (HI*TEMP71/3.0+ TI*TEMP61)) - (EPHK2 *
     1 TEMP8*(HI*TEMP72/3.0+TØ*TEMP62))
      GØ TØ 714
  813 TI = (E2*HØ**2-E1*HI**2+2.0*E2*HØ*T)/(2.0*(E1*HI+E2*HØ))
      TØ = (E1*HI**2-E2*HØ**2+2.0*E1*HI*T)/(2.0*(E1*HI+E2*HØ))
      XNTTH = ETHK1*0.5*(HI*TEMP61)+ETHK2*0.5*(HØ*TEMP62)
      XNTPH= EPHK1*0.5*(HI*TEMP61)+ EPHK2*0.5*(HØ*TEMP62)
      XMTTH = ETHK1*0.5*(HI**2*TEMP71/3.0+TI*HI*TEMP61)-ETHK2*0.5*(HØ
     1**2*TEMP72/3.+ TØ*HØ*TEMP62)
      XMTPH = EPHK1*0.5*(HI**2*TEMP71/3.0+TI*HI*TEMP61)-EPHK2*0.5*(HØ
     1**2*TEMP72/3.+ TØ*HØ*TEMP62)
      GØ TØ 714
  814 TEMP10=((-XK11*XD11)**.5)/(48.0**.5)
      TEM11 =((-XK22*XD22)**.5)/(48.0**.5)
      XNTTH =(XK11/4.0 *TEMP11)* TEMP61 + (XK11/4.0*TEMP12) * TEMP62
      XNTPH =(XK22/4.0 *TEMP21)* TEMP61 + (XK22/4.0*TEMP22) * TEMP62
      XMTTH =  TEMP10*(TEMP11*TEMP71 - TEMP12* TEMP72)
      XMTPH =  TEM11 *(TEMP21*TEMP71 - TEMP22* TEMP72)
  714 CØNTINUE
 8889 RETURN
      END
```

```
FØR,IS TEMØEG,TEMØEG
      SUBRØUTINE TEMØEG
C     THIS SUBRØUTINE CALCULATES THE GEØMETRY FØR A SHELL SEGMENT.
C     THE INPUT VARIABLES ARE . . .
C              RI(I) - - DISTANCE FRØM AXIS ØF REV. TØ PØINTS
C                        ØN SHELL MERIDIAN.
C              ZI(I) - - DISTANCE ALØNG AXIS ØF REV. TØ THE
C                        INTERSECTIØN ØF THE CØRRESPØNDING RI(I) AND
C                        THE AXIS ØF REV.
C              NRZIN - - NUMBER ØF (RI,ZI) PAIRS READ AS INPUT.
C
      CØMMØN /SNILPS/ ANG,PSI(100),RAD(100),CUR1(100),CUR2(100),
     1        DR1DP(100),ZI(14),RI(14),NRZIN
      DIMENSIØN CI(4,13),DRDZ(14),SØUT(14),S(101),RADD(100)
C
      FUN(ARG) = SQRT(1.0 + ARG**2)
C
      RADS = 3.1415926/180.0
      DATA B/-B   -/
      AMULT = 1.0
      IF (ANG.EQ.B) AMULT = -1.0
C
C     PASS SPLINE CURVE THRØUGH INPUT PØINTS ØN SHELL MERIDIAN, AND
C     CØMPUTE DR/DZ AT THESE PØINTS.
C
      CALL PLYCØ (ZI,RI,NRZIN,CI)
      NDELZ = NRZIN - 1
      DØ 60 I=1,NRZIN
      CALL PLYNE (ZI,RI,NRZIN,CI,ZI(I),FAKE1,DRDZ(I),FAKE2)
   60 CØNTINUE
C
C     CØMPUTE MERIDIØNAL ARC LENGTH TØ INTERPØLATED PØINTS BY
C     NUMERICAL INTEGRATIØN (SIMPSØNS RULE).  SINCE SIMPSØNS RULE
C     REQUIRES AN EVEN NUMBER ØF PARTITIØNS, INTERPØLATE A PØINT
C     MIDWAY BETWEEN EACH PAIR ØF PØINTS USING SUBRØUTINE  PLINE.
C
      SØUT(1) = 0.
      DØ 70 I=1,NDELZ
      DZ2=(ZI(I+1)-ZI(I))/2.0
      DZ6=DZ2/3.0
      CALL PLYNE (ZI,RI,NRZIN,CI,ZI(I)+DZ2,FAKE1,DRDZM,FAKE2)
      SØUT(I+1) = SØUT(I) + DZ6*(FUN(DRDZ(I)) + 4.0*FUN(DRDZM) +
     1             FUN(DRDZ(I+1)))
   70 CØNTINUE
C
C     USE SPLICØ TØ REPRESENT RI(I) AS A FUNCTIØN ØF SØUT(I).  THEN USE
C     SPLINE TØ INTERPØLATE RADD AND CØRRESPØNDING DERIVATIVES.  FRØM
C     THESE, CØMPUTE THE TWØ PRINCIPAL RADII ØF CURVATURE,
C       CUR1 = 1/R1
C       CUR2 = 1/R2
C
      ØLDH1 = SØUT(NRZIN)/99.0
      CALL PLYCØ (SØUT,RI,NRZIN,CI)
      DØ 110 I=1,100
      S(I) = FLØAT(I-1)*ØLDH1
      CALL PLYNE (SØUT,RI,NRZIN,CI,S(I),RAD(I),RADD(I),RADD2)
      IF (ABS(RADD(I)).GT.1.0) RADD(I)=1.0
      FACTØR = SQRT(1.0-RADD(I)**2)
      CUR1(I) = -RADD2/FACTØR
      CUR2(I) = FACTØR/RAD(I)
  110 CØNTINUE
```

```
      DØ 180 J=1,100
      CØSPSI = AMULT*RADD(J)
      PSI(J) = ARCØS(CØSPSI)
      SINPSI = -AMULT*RAD(J)*CUR2(J)
      IF (ANG.EQ.B) GØ TØ 179
      PSI(J) = 2.0*3.1415926-PSI(J)
  179 CØNTINUE
      CUR1(J) = -AMULT/CUR1(J)
      CUR2(J) = -AMULT/CUR2(J)
      IF (J.EQ.1) GØ TØ 180
      I = 1
      IF (J.EQ.2) GØ TØ 181
      I = 2
  181 IF (ANG.EQ.B) GØ TØ 190
      DR1DP(J-1) = (CUR1(J)-CUR1(J-I))/(PSI(J)-PSI(J-I))
      GØ TØ 180
  190 DR1DP(J-1) = (CUR1(J-I)-CUR1(J))/(PSI(J-I)-PSI(J))
  180 CØNTINUE
      DR1DP(100) = DR1DP(99)
      DØ 42 J=1,100
      DR1DP(J) = DR1DP(J)*0.1
   42 CØNTINUE
      RETURN
      END
```

```
FØR,IS PLYCØ,PLYCØ
      SUBRØUTINE PLYCØ (X,Y,M,C)
C     SUBRØUTINE TØ DETERMINE C(1,K),C(2,K),C(3,K) AND C(4 K).
      DIMENSIØN X(14),Y(14),A(14,3),B(14),Z(14)
      DIMENSIØN D(13),P(13),E(13),C(4,13)
      MM = M-1
      DØ 10 K=1,MM
      D(K) = X(K+1) - X(K)
      P(K) = D(K)/6.0
   10 E(K) = (Y(K+1)-Y(K))/D(K)
      DØ 20 K=2,MM
   20 B(K) = E(K) - E(K-1)
      A(1,2) = -1.0-D(1)/D(2)
      A(1,3) = D(1)/D(2)
      A(2,3) = P(2)-P(1)*A(1,3)
      A(2,2) = 2.0*(P(1)+P(2)) - P(1)*A(1,2)
      A(2,3) = A(2,3)/A(2,2)
      B(2) = B(2)/A(2,2)
      DØ 30 K=3,MM
      A(K,2) = 2.0*(P(K-1)+P(K))-P(K-1)*A(K-1,3)
      B(K) = B(K)-P(K-1)*B(K-1)
      A(K,3) = P(K)/A(K,2)
   30 B(K) = B(K)/A(K,2)
      Q = D(M-2)/D(M-1)
      A(M,1) = 1.0+Q+A(M-2,3)
      A(M,2) = -Q-A(M,1)*A(M-1,3)
      B(M) = B(M-2)-A(M,1)*B(M-1)
      Z(M) = B(M)/A(M,2)
      MN = M-2
      DØ 40 I=1,MN
      K = M-I
   40 Z(K) = B(K)-A(K,3)*Z(K+1)
      Z(1) = -A(1,2)*Z(2)-A(1,3)*Z(3)
      DØ 50 K=1,MM
      Q = 1.0/(6.0*D(K))
      C(1,K) = Z(K)*Q
      C(2,K) = Z(K+1)*Q
      C(3,K) = Y(K)/D(K)-Z(K)*P(K)
   50 C(4,K) = Y(K+1)/D(K)-Z(K+1)*P(K)
      RETURN
      END
```

```
FØR,IS PLYNE,PLYNE
      SUBRØUTINE PLYNE (X,Y,M,C,XINT,YINT,DYDX,D2YDX2)
C     SUBRØUTINE FØR SPLINE FIT INTERPØLATIØN IN THE TABLE ØF VALUES
C     (X1,Y1) TØ (XM,YM), WHERE M MAY BE AS LARGE AS 100,  HERE THE
C     CØNSTANTS C(1,K),C(2,K),C(3,K) AND C(4,K) ARE ALREAD  CØMPUTED
C     AND STØRED.
C     SUBRØUTINE ALSØ CØMPUTES DY/DX AND D2Y/DX2 AT XINT.
      DIMENSIØN X(14),Y(14),C(4,13)
      IF (XINT-X(1)) 80,10,20
   10 YINT = Y(1)
      K=1
      GØ TØ 70
   20 K = 1
   30 IF (XINT-X(K+1)) 60,40,50
   40 YINT = Y(K+1)
      GØ TØ 70
   50 K = K + 1
      IF (M-K) 80,80,30
   60 YINT = (X(K+1) - XINT)*(C(1,K)*(X(K+1)-XINT)**2+C(3,K))
      YINT = YINT + (XINT-X(K))*(C(2,K)*(XINT-X(K))**2+C(4,K))
   70 DYDX=-3.0*(C(1,K)*(X(K+1)-XINT)**2-C(2,K)*(XINT-X(K))**2)
     1      -C(3,K)+C(4,K)
      D2YDX2=6.0*(C(1,K)*(X(K+1)-XINT)+C(2,K)*(XINT-X(K)))
      RETURN
   80 WRITE (6,90)
   90 FØRMAT (31H ØUT ØF RANGE FØR INTERPØLATIØN)
      RETURN
      END
```

SUBROUTINES ODE1 AND ODE2

Subroutine LEBEGE calls either ODE1 or ODE2, as necessary, and various geometric and trigonometric clues, as well as the predicted values of the variables for the differential equations, are passed to this subprogram via label common area LASTEQ.

The equations in ODE1 and ODE2 are identical to those in subroutines DIF1 and DIFF2 respectively, with the addition of the auxiliary equations for YAQPH, and YAQTH. Subroutines ODE1 and ODE2 perform the final integration for each segment in the structure utilizing the initial conditions previously obtained, and return these values to LEBEGE via label common area LASTEQ.

The ODE1, ODE2 flow charts are identical to the DIF1, DIFF2 flow charts, respectivel

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
YANPT	$N_{\phi\theta}$
YAQPH	Q_{ϕ}
YAQTH	Q_{θ}
YAOPH	Ω_{ϕ}

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FØR,IS ØDE1,ØDE1
      SUBRØUTINE ØDE1                                                   2000030
      INTEGER SAVJTC,SAVSTP,Q,THICK
      CØMMØN STØRY(16),TALE(16),XMAT(110,10),STD(10),SADUS(30),RADUS(30) 2000050
      CØMMØN TADUS(30),UADUS(30),SAVTIC(900)                            2000060
      CØMMØN XN,TEFREE,TIC,PHI,STØP,RESTØP,RTICK,G1,XNL                 2000070
      CØMMØN NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)  2000080
      CØMMØN JRSTØP(30),NREG,NSEGTL,NMPT,MATPRP,NCUPLE,NRGEND,NSYM,NRG  2000090
      CØMMØN NRC,NSC,NIX,IERRØR,IØUT,MAT,KGEØM,IGEØM,ITYPE,ISTTAB,KELVIN 2000100
      CØMMØN IBEGIN,NPRØB,NHARM,NSEG,NERRØR, Q ,NSMAX,THICK             2000110
      EQUIVALENCE (XMTTH,XMTETH),(XMTPH,XMTEPH),(XNTTH,XNTETH),         2000120
     1            (XNTPH,XNTEPH)                                        2000130
      CØMMØN /LASTEQ/ YPRED( 80),YDØT( 80),YASAVE( 80),                 2000140
     1               YANTH,YAMTH,YAMPT,YANPT,YAØPH,YAQPH,YAQTH,YAJPH,   2000150
     2               S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,         2000160
     3               X1RØ,X1RØSQ,X1SNRØ,X1CSRØ,CN1RØ,SN1RØ,CS1RØ,       2000170
     4               X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RØ,BESQ,   2000180
     5    RØSQ,XNSQ,BETA,R1,R2,S1,R1DØT,R1SQ,                           2000190
     6               XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,      2000200
     7  XMTHLD,XMPHLD,ETHET(2),EPHI(2),XGPT(2),ALPHTH(2),ALPHPH(2),     2000210
     8               XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,    2000220
     9               XK11,XK12,XK21,XK22,XK33,XD11,                     2000230
     A                  M,I,SITIN,SITØUT,SIPIN,SIPØUT,TPTIN,TPTØUT,     2000240
     B            ZBRIN,ZBRØUT,SCRIPA,SCRIPI,SIFIN,SIFØUT,TZEPH,TZETH   2000250
     B , XNPHI,BETTA,XC16,XC14,XC25                                     2000260
      EQUIVALENCE  (XNPHI,XNPI)                                         2000270
      DØUBLE PRECISIØN YPRED                                            2000280
      IF(ISTTAB.EQ.1)  GØ TØ 7786                                       2000290
      IF(ISTTAB.GE.10)GØ TØ 7786                                        2000300
C     THE FØLLØWING EQUATIØNS ARE THE -THICK- SET                       2000310
      GØ TØ (151,152,153),IGEØM                                         2000320
C   EQUATIØNS FØR SHELLS ØF REVØLUTIØN  ( PHI  CØØRDINATE )             2000330
  151 YANTH=XNUPT*YPRED(I+1)+(XK11-XNUPT**2*XK22)*(XN*YPRED(I+4)+YPRED( 2000340
     1      I+5)*CS-YPRED(I+6)*SN)*X1RØ-XNTETH+XNUPT*XNTEPH             2000350
      YAMTH=XNUPT*YPRED(I+3)-(XD11-XNUPT**2*XD22)*X1RØ*(X1RØ*(XN*YPRED  2000360
     1      (I+4)*SN-XNSQ*YPRED(I+6))+YPRED(I+7)*CS)-XMTETH+XNUPT*XMTEPH 2000370
      YAMPT=(-1.0/((RØ/XD33)+(SNSQ*X1RØ/XK33)))*(-2.0*XN*YPRED(I+7)+YPRE 2000380
     1      D(I+4)*(CS1R1-CN1RØ)+XN*YPRED(I+5)*(SN1RØ+X1R1)+2.0*XN*YPRED 2000390
     2      (I+6)*CS1RØ+YPRED(I)*SN/XK33)                               2000400
      YAJPH = YPRED(I+2)-XNL*(XNPI*YPRED(I+7))                          2000410
      YANPT=YPRED(I)+YAMPT*SN1RØ                                        2000420
      YAØPH=XN*YPRED(I+6)*X1RØ-YPRED(I+4)*SN1RØ                         2000430
      YAQPH=YPRED(I+2)-XN*YAMPT*X1RØ                                    2000440
      YDØT(I)=R1*(-2.0*YPRED(I)*CS1RØ+XN*YANTH*X1RØ-XN*YAMTH*SN*X1RØSQ- 2000450
     1        YAMPT*CS1RØ*(X1R1-SN1RØ)-XFTHLD-XMPHLD*SN1RØ)             2000460
      YDØT(I+5)=R1*(YPRED(I+6)*X1R1+(1.0/(XK22-XNUTP**2*XK11))*(YPRED(I+ 2000470
     1          1)-XNUTP*YANTH+XNTEPH-XNUTP*XNTETH))                    2000480
      YDØT(I+1) =(-YPRED(I+1)*CS1RØ+YANTH*CS1RØ-XN*YPRED(I)*X1RØ-XN*    2000490
     1           YAMPT*X1RØ*(SN*X1RØ+X1R1)+YPRED(I+2)*X1R1-XFPHLD-      2000500
     2            XNL*(XFPHLD*(YPRED(I+5)*CS1RØ-YPRED(I+6)*(X1R1+SN1RØ) 2000510
     3            +YDØT (I+5)*X1R1)-XFZELD*YPRED(I+7)))*R1              2000520
      YDØT(I+2) =(-YAJPH*CS*X1RØ-YANTH*SN1RØ-YPRED(I+1)*X1R1+XNSQ*YAMTH* 2000530
     1           X1RØSQ-2.0*XN*YAMPT*CS*X1RØSQ+XN*XMPHLD*X1RØ-XFZELD-XNL 2000540
     2          *(XFZELD*(YPRED(I+5)*CS*X1RØ-YPRED(I+6)*(X1R1+SN1RØ)+   2000550
     3           YDØT (I+5)*X1R1)+XFPHLD*YPRED(I+7))-XNL*CS1RØ*(XNPI*   2000560
     4           YPRED(I+7)))*R1                                        2000570
      YDØT(I+3) = R1*(YAMTH*CS1RØ-YPRED(I+3)*CS1RØ-2.0*XN*YAMPT*X1RØ+   2000580
     1            YAJPH+XMTHLD)                                         2000590
      YDØT(I+4)=R1*(YPRED(I+4)*CS1RØ+XN*YPRED(I+5)*X1RØ+YPRED(I)/XK33+  2000600
     1          YAMPT*SN*X1RØ/XK33)                                     2000610
      YDØT(I+6)=R1*(YPRED(I+7)-YPRED(I+5)*X1R1)                         2000620
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      YDØT(I+7)=R1*(1.0/(XD22-XNUTP**2*XD11))*(-YPRED(I+3)+XNUTP*YAMTH-
     1           XMTEPH+XNUTP*XMTETH)
      YAQTH=(3.0*CS1RØ-(2.0*CS*(RØ*XK33+XD33*SN1R1))/(RØSQ*XK33+XD33*SNS
     1      Q))*YAMPT+(-X1R1/(RØ/XD33+SNSQ*X1RØ/XK33))*(-2.*XN*YDØT(I+7
     2      )+YDØT (I+4)*(CS1R1-CN1RØ)+YPRED(I+4)*(SN*SN1RØ-CS*CS1RØ-SN1
     3      R1-R1DØT*CS1R1*X1R1+R1*CS1RØ**2*SN)+XN*YDØT(I+5)*(SN1RØ
     4      +X1R1)+XN*YPRED(I+5)*(CS1RØ-R1*CN*X1RØSQ-R1DØT*X1R1**2)+2.0*
     5      XN*YDØT(I+6)*CS1RØ-2.0*XN*YPRED(I+6)*(SN1RØ+R1*CS1RØ**2)+
     6      YDØT(I)*SN/XK33+YPRED(I)*CS/XK33)-XN*YAMTH*X1RØ-XMPHLD
      IF(XN.EQ.0.0.AND.XFTHLD.EQ.0.0.AND.XMPHLD.EQ.0.0)  YAQTH=0.0
      GØTØ 9005
C     EQUATIØNS FØR CØNE
  152 YANTH=XNUPT*YPRED(I+1)+(XK11-XNUPT**2*XK22)*(X1CS/S)*(XN*YPRED(I+4
     1      )+YPRED(I+5)*CS-YPRED(I+6)*SN)-XNTETH+XNUPT*XNTEPH
      YAMTH=XNUPT*YPRED(I+3)-(1.0/S)*X1CS*(XD11-XNUPT**2*XD22)*((1.0/S)*
     1      X1CS*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+YPRED(I+7)*CS)-
     2      XMTETH+XNUPT*XMTEPH
      YAMPT=(-1.0/((S*CS/XD33)+(SN*TN/(XK33*S))))*(-2.0*XN*YPRED(I+7)-
     1      YPRED(I+4)*SN/S+XN*YPRED(I+5)*TN/S+2.0*XN*YPRED(I+6)/S+YPRED
     2      (I)*SN/XK33)
      YAJPH = YPRED(I+2)-XNL*(XNPHI*YPRED(I+7))
      YANPT=YPRED(I)+YAMPT*TN/S
      YAØPH=XN*YPRED(I+6)*X1CS/S-YPRED(I+4)*TN/S
      YAQPH=YPRED(I+2)-XN*YAMPT*X1CS/S
      YDØT(I)  =-2.0*YPRED(I)/S+XN*YANTH*X1CS/S-XN*YAMTH*SN*X1CS**2/S**2
     1           +YAMPT*TN/S**2-XFTHLD-XMPHLD*TN/S
      YDØT(I+5)=(1.0/(XK22-XNUTP**2*XK11))*(YPRED(I+1)-XNUTP*YANTH+XNTEP
     1           H-XNUTP*XNTETH)
      YDØT(I+1)= -YPRED(I+1)/S+YANTH/S-XN*YPRED(I)/(S*CS)-XN*YAMPT*SN/
     1             (S**2*CS**2)-XFPHLD-XNL*(XFPHLD*(YPRED(I+5)/S-YPRED
     2             (I+6)*TAN/S+YDØT(I+5))-XFZELD*YPRED(I+7))
      YDØT(I+2)= -YAJPH/S-YANTH*TAN/S+XNSQ*YAMTH/(S**2*CS**2)-2.0*XN*
     1           YAMPT/(S**2*CS)+XN*XMPHLD/(S*CS)-XFZELD-XNL*(XFZELD*(
     2             YPRED(I+5)/S-YPRED(I+6)*TAN/S+YDØT(I+5))+XFPHLD*YPRED
     3            (I+7))-XNL*XNPHI*YPRED(I+7)/S
      YDØT(I+3)= YAMTH/S-YPRED(I+3)/S-2.0*XN*YAMPT/(S*CS)+YAJPH+XMTHLD
      YDØT(I+4)=(1.0/S)*(YPRED(I+4)+XN*YPRED(I+5)*X1CS+YAMPT*TN/XK33)
     1           +YPRED(I)/XK33
      YDØT(I+6)=YPRED(I+7)
      YDØT(I+7)=(1.0/(XD22-XNUTP**2*XD11))*(-YPRED(I+3)+XNUTP*YAMTH-
     1           XMTEPH+XNUTP*XMTETH)
      YAQTH=(3.0/S-2.0*XK33*S*CS**2/(XK33*S**2*CS**2+XD33*SN**2))*YAMPT+
     1      (-1.0/((S*CS/XD33)+(SN**2*X1CS/(XK33*S))))*(-2.0*XN*YDØT(I+7
     2      )-YDØT(I+4)*SN/S+YPRED(I+4)*SN/S**2+XN*YDØT(I+5)*TN/S-XN*
     3      YPRED(I+5)*TN/S**2+2.0*YDØT(I+6)*XN/S-2.0*XN*YPRED(I+6)/S**2
     4      +YDØT(I)*SN/XK33)-XN*YAMTH*X1CS/S-XMPHLD
      IF(XN.EQ.0.0.AND.XFTHLD.EQ.0.0.AND.XMPHLD.EQ.0.0)  YAQTH=0.0
      GØ TØ 9005
C     EQUATIØNS FØR CYLINDER
  153 YANTH=XNUPT*YPRED(I+1)+(XK11-XNUPT**2*XK22)*(X1RØ*(XN*YPRED(I+4)-
     1      YPRED(I+6)))-XNTETH+XNUPT*XNTEPH
      YAMTH=XNUPT*YPRED(I+3)-(X1RØ*(XD11-XNUPT**2*XD22))*(X1RØ*(XN*YPRED
     1      (I+4)-XN**2*YPRED(I+6)))-XMTETH+XNUPT*XMTEPH
      YAMPT=(-1.0/((RØ/XD33)+(X1RØ/XK33)))*(-2.0*XN*YPRED(I+7)+XN*X1RØ*
     2      YPRED(I+5)+YPRED(I)/XK33)
      YAJPH = YPRED(I+2) - XNL * (XNPHI*YPRED(I+7))
      YANPT=YPRED(I)+YAMPT*X1RØ
      YAØPH=X1RØ*(XN*YPRED(I+6)-YPRED(I+4))
      YAQPH=YPRED(I+2)-XN*YAMPT*X1RØ
      YDØT(I)  =XN*YANTH*X1RØ-XN*YAMTH*X1RØSQ-XFTHLD-XMPHLD*X1RØ
      YDØT(I+5)=(1.0/(XK22-XNUTP**2*XK11))*(YPRED(I+1)-XNUTP*YANTH+XNTEP
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     1          H-XNUTP*XNTETH)
      YDØT(I+1) = -XN*X1RØ*YPRED(I)-XN*YAMPT*X1RØSQ-XFPHLD-XNL*(XFPHLD*
     1             (YDØT(I+5)-YPRED(I+6)*X1RØ)-XFZELD*YPRED(I+7))
      YDØT(I+2) = -YANTH*X1RØ+XNSQ*YAMTH*X1RØSQ+XN*XMPHLD*X1RØ-XFZELD-
     1             XNL*(XFZELD*(YDØT(I+5)-YPRED(I+6)*X1RØ)+XFPHLD*YPRED(
     2             I+7))
      YDØT(I+3) = -2*XN*YAMPT*X1RØ+YAJPH+XMTHLD
      YDØT(I+4)=XN*YPRED(I+5)*X1RØ+YPRED(I)/XK33+YAMPT*X1RØ/XK33
      YDØT(I+6)=YPRED(I+7)
      YDØT(I+7)=(1.0/(XD22-XNUTP**2*XD11))*(-YPRED(I+3)+XNUTP*YAMTH-XMTE
     1          PH+XNUTP*XMTETH)
      YAQTH=(-1.0/((RØ/XD33)+(X1RØ/XK33)))*(-2.0*XN*YDØT(I+7)+XN*YDØT(I+
     1     5)*X1RØ+YDØT(I)/XK33)-XN*YAMTH*X1RØ-XMPHLD
      IF(XN.EQ.0.0.AND.XFTHLD.EQ.0.0.AND.XMPHLD.EQ.0.0)  YAQTH=0.0
      GØ TØ 9005
 7786 GØ TØ (4771,4772,4773),IGEØM
C     THE FØLLØWING EQUATIØNS ARE THE -ST10- SET
C   EQUATIØNS FØR SHELLS ØF REVØLUTIØN  ( PHI  CØØRDINATE )
 4771 YANTH= XK12*(1.0/(XK22+XC22**2/XD22))*(YPRED(I+1)+XNTPH+(XC22/XD22
     1       )*(YPRED(I+3)+XMTPH))-XNTTH+(X1RØ*XK11-XK12*XK21*X1RØ*(1.0/
     2       (XK22+XC22**2/XD22)))*(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+
     3      6)*SN)-(XC11+XK12*XC22*XD21/XD22*(1.0/(XK22+XC22**2/XD22)))*
     4       (X1RØ**2*(XN*YPRED(I+4)*SN-XN**2*YPRED(I+6))+YPRED(I+7)*CS*
     5       X1RØ)
      YAMTH =-XD12*(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+XNTPH)-XMTTH
     1        +XD12*(XK22/(XC22**2+XK22*XD22))*(YPRED(I+3)+XMTPH)+(XC11*
     2        X1RØ+XD12*XK21*X1RØ*(XC22/(XC22**2+XK22*XD22)))*(XN*YPRED(
     3        I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)+(XD11-XD12*XK22*XD21/(
     4        XC22**2+XK22*XD22))*(X1RØSQ*(XN*YPRED(I+4)*SN-XNSQ*YPRED
     5        (I+6))+YPRED(I+7)*CS*X1RØ)
      YAMPT=(-1.0/((RØ/XD33)+(SNSQ*X1RØ/XK33)))*(-2.0*XN*YPRED(I+7)+YPRE
     1      D(I+4)*(CS1R1-CN1RØ)+XN*YPRED(I+5)*(SN1RØ+X1R1)+2.0*XN*YPRED
     2      (I+6)*CS1RØ+YPRED(I)*SN/XK33)
      YAJPH = YPRED(I+2)-XNL*(XNPI*YPRED(I+7))
      YANPT=YPRED(I)+YAMPT*SN1RØ
      YAØPH=XN*YPRED(I+6)*X1RØ-YPRED(I+4)*SN1RØ
      YAQPH=YPRED(I+2)-XN*YAMPT*X1RØ
      YDØT(I)=R1*(-2.0*YPRED(I)*CS1RØ+XN*YANTH*X1RØ-XN*YAMTH*SN*X1RØSQ-
     1        YAMPT*CS1RØ*(X1R1-SN1RØ)-XFTHLD-XMPHLD*SN1RØ)
      YDØT (I+5)=R1*(YPRED(I+6)*X1R1+(1.0/(XK22+XC22**2/XD22))*(YPRED(I+
     1           1)+XNTPH+(XC22/XD22)*(YPRED(I+3)+XMTPH)-XK21*X1RØ*(XN*
     2           YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)-(XC22*XD21/XD22
     3           )*(X1RØSQ*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+YPRED(I+7)
     4           *CS*X1RØ)))
      YDØT(I+1) =(-YPRED(I+1)*CS1RØ+YANTH*CS1RØ-XN*YPRED(I)*X1RØ-XN*
     1           YAMPT*X1RØ*(SN*X1RØ+X1R1)+YPRED(I+2)*X1R1-XFPHLD-
     2            XNL*(XFPHLD*(YPRED(I+5)*CS1RØ-YPRED(I+6)*(X1R1+SN1RØ)
     3            +YDØT  (I+5)*X1R1)-XFZELD*YPRED(I+7)))*R1
      YDØT(I+2) =(-YAJPH*CS*X1RØ-YANTH*SN1RØ-YPRED(I+1)*X1R1+XNSQ*YAMTH*
     1           X1RØSQ-2.0*XN*YAMPT*CS*X1RØSQ+XN*XMPHLD*X1RØ-XFZELD-XNL
     2          *(XFZELD*(YPRED(I+5)*CS*X1RØ-YPRED(I+6)*(X1R1+SN1RØ)+
     3           YDØT  (I+5)*X1R1)+XFPHLD*YPRED(I+7))-XNL*CS1RØ*(XNPI*
     4           YPRED(I+7)))*R1
      YDØT(I+3) = R1*(YAMTH*CS1RØ-YPRED(I+3)*CS1RØ-2.0*XN*YAMPT*X1RØ+
     1            YAJPH+XMTHLD)
      YDØT(I+4)=R1*(YPRED(I+4)*CS1RØ+XN*YPRED(I+5)*X1RØ+YPRED(I)/XK33+
     1          YAMPT*SN*X1RØ/XK33)
      YDØT(I+6)=R1*(YPRED(I+7)-YPRED(I+5)*X1R1)
      YDØT(I+7)=R1*((-XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+XNTPH-(XK21/
     1          RØ)*(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN))
     2          +(XK22/(XC22**2+XK22*XD22))*(YPRED(I+3)+XMTPH)-(XK22*
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3           XD21/(XC22**2+XK22*XD22))*(X1RØSQ*(XN*YPRED(I+4)*SN-XNSQ
4           *YPRED(I+6))+YPRED(I+7)*CS*X1RØ))
      YAQTH=(3.0*CS1RØ-(2.0*CS*(RØ*XK33+XD33*SN1R1))/(RØSQ*XK33+XD33*SNS
1        Q))*YAMPT+(-X1R1/(RØ/XD33+SNSQ*X1RØ/XK33))*(-2.*XN*YDØT(I+7
2        )+YDØT (I+4)*(CS1R1-CN1RØ)+YPRED(I+4)*(SN*SN1RØ-CS*CS1RØ-SN1
3        R1-R1DØT*CS1R1*X1R1+R1*CS1RØ**2*SN)+XN*YDØT(I+5)*(SN1RØ
4        +X1R1)+XN*YPRED(I+5)*(CS1RØ-R1*CN*X1RØSQ-R1DØT*X1R1**2)+2.0*
5        XN*YDØT(I+6)*CS1RØ-2.0*XN*YPRED(I+6)*(SN1RØ+R1*CS1RØ**2)+
6        YDØT(I)*SN/XK33+YPRED(I)*CS/XK33)-XN*YAMTH*X1RØ-XMPHLD
      IF(XN.EQ.0.0.AND.XFTHLD.EQ.0.0.AND.XMPHLD.EQ.0.0)  YAQTH=0.0
      GØ TØ 9005
C     EQUATIØNS FØR CØNE
 4772 YANTH= XK12*(1.0/(XK22+XC22**2/XD22))*(YPRED(I+1)+XNTPH+(XC22/XD22
1         )*(YPRED(I+3)+XMTPH))-XNTTH+(1.0/(CS*S))*(XK11-XK12*XK21*(
2         1.0/(XK22+XC22**2/XD22)))*(XN*YPRED(I+4)+YPRED(I+5)*CS-
3         YPRED(I+6)*SN)-(XC11+(XK12*XD21*XC22/XD22)*(1.0/(XK22+XC22*
4         *2/XD22)))*((1.0/(S**2*CS**2))*(XN*YPRED(I+4)*SN-XNSQ*YPRED
5         (I+6))+YPRED(I+7)/S)
      YAMTH =-XD12*(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+XNTPH)-XMTTH+
1          XD12*(XK22/(XC22**2+XK22*XD22))*(YPRED(I+3)+XMTPH)+(XC11/
2          (S*CS)+XD12*XK21/(S*CS))*(XC22/(XC22**2+XK22*XD22))*(XN*
3          YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)+(XD11-XD12*XK22*
4          XD21/(XC22**2+XK22*XD22))*((1.0/(S*CS)**2)*(XN*YPRED(I+4)*
5          SN-XNSQ*YPRED(I+6))+YPRED(I+7)/S)
      YAMPT=(-1.0/((S*CS/XD33)+(SN*TN/(XK33*S))))*(-2.0*XN*YPRED(I+7)-
1        YPRED(I+4)*SN/S+XN*YPRED(I+5)*TN/S+2.0*XN*YPRED(I+6)/S+YPRED
2        (I)*SN/XK33)
      YAJPH = YPRED(I+2)-XNL*(XNPHI*YPRED(I+7))
      YANPT=YPRED(I)+YAMPT*TN/S
      YAØPH=XN*YPRED(I+6)*X1CS/S-YPRED(I+4)*TN/S
      YAQPH=YPRED(I+2)-XN*YAMPT*X1CS/S
      YDØT(I)  =-2.0*YPRED(I)/S+XN*YANTH*X1CS/S-XN*YAMTH*SN*X1CS**2/S**2
1           +YAMPT*TN/S**2-XFTHLD-XMPHLD*TN/S
      YDØT(I+5)=(1.0/(XK22+XC22**2/XD22))*(YPRED(I+1)+XNTPH+(XC22/XD22)*
1           (YPRED(I+3)+XMTPH)-(XK21/(S*CS))*(XN*YPRED(I+4)+YPRED(
2           I+5)*CS-YPRED(I+6)*SN)-(XC22*XD21/XD22)*((1.0/(S**2*CS**
3           2))*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+YPRED(I+7)/S))
      YDØT(I+1)= -YPRED(I+1)/S+YANTH/S-XN*YPRED(I)/(S*CS)-XN*YAMPT*SN/
1            (S**2*CS**2)-XFPHLD-XNL*(XFPHLD*(YPRED(I+5)/S-YPRED
2            (I+6)*TAN/S+YDØT(I+5))-XFZELD*YPRED(I+7))
      YDØT(I+2)= -YAJPH/S-YANTH*TAN/S+XNSQ*YAMTH/(S**2*CS**2)-2.0*XN*
1           YAMPT/(S**2*CS)+XN*XMPHLD/(S*CS)-XFZELD-XNL*(XFZELD*(
2             YPRED(I+5)/S-YPRED(I+6)*TAN/S+YDØT(I+5))+XFPHLD*YPRED
3            (I+7))-XNL*XNPHI*YPRED(I+7)/S
      YDØT(I+3)= YAMTH/S-YPRED(I+3)/S-2.0*XN*YAMPT/(S*CS)+YAJPH+XMTHLD
      YDØT(I+4)=(1.0/S)*(YPRED(I+4)+XN*YPRED(I+5)*X1CS+YAMPT*TN/XK33)
1           +YPRED(I)/XK33
      YDØT(I+6)=YPRED(I+7)
      YDØT(I+7)=-(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+XNTPH-XK21*(XN*
1           YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)/(S*CS))+
2           (XK22/(XC22**2+XK22*XD22))*(YPRED(I+3)+XMTPH)-(XK22*XD21
3           /(XC22**2+XK22*XD22))*((1.0/(S*CS)**2)*(XN*YPRED(I+4)*SN
4           -XN**2*YPRED(I+6))+YPRED(I+7)/S)
      YAQTH=(3.0/S-2.0*XK33*S*CS**2/(XK33*S**2*CS**2+XD33*SN**2))*YAMPT+
1        (-1.0/((S*CS/XD33)+(SN**2*X1CS/(XK33*S))))*(-2.0*XN*YDØT(I+7
2        )-YDØT(I+4)*SN/S+YPRED(I+4)*SN/S**2+XN*YDØT(I+5)*TN/S-XN*
3        YPRED(I+5)*TN/S**2+2.0*YDØT(I+6)*XN/S-2.0*XN*YPRED(I+6)/S**2
4        +YDØT(I)*SN/XK33)-XN*YAMTH*X1CS/S-XMPHLD
      IF(XN.EQ.0.0.AND.XFTHLD.EQ.0.0.AND.XMPHLD.EQ.0.0)  YAQTH=0.0
      GØ TØ 9005
      EQUATIØNS FØR CYLINDER
```

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4773 YANTH= XK12*(1.0/(XK22+XC22**2/XD22))*(YPRED(I+1)+XNTPH+(XC22/XD22
    1      )*(YPRED(I+3)+XMTPH))-XNTTH+(X1RØ*(XK11-XK12*XK21*(1.0/(
    2      XK22+XC22**2/XD22))))*(XN*YPRED(I+4)-YPRED(I+6))-(XC11+(
    3      XK12*XC22*XD21/XD22)*(1.0/(XK22+XC22**2/XD22)))*(X1RØ**2*(
    4      XN*YPRED(I+4)-XNSQ*YPRED(I+6)))
     YAMTH =-XD12*(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+XNTPH)-XMTTH+
    1       XD12*(XK22/(XC22**2+XK22*XD22))*(YPRED(I+3)+XMTPH)+(XC11*
    2       X1RØ+XD12*XK21*X1RØ*(XC22/(XC22**2+XK22*XD22)))*(XN*YPRED
    3       (I+4)-YPRED(I+6))+(XD11-XD12*XK22*XD21/(XC22**2+XK22*XD22)
    4       )*(X1RØSQ*(XN*YPRED(I+4)-XNSQ*YPRED(I+6)))
     YAMPT=(-1.0/((RØ/XD33)+(X1RØ/XK33)))*(-2.0*XN*YPRED(I+7)+XN*X1RØ*
    1      YPRED(I+5)+YPRED(I)/XK33)
     YAJPH = YPRED(I+2) - XNL * (XNPHI*YPRED(I+7))
     YANPT=YPRED(I)+YAMPT*X1RØ
     YAØPH=X1RØ*(XN*YPRED(I+6)-YPRED(I+4))
     YAQPH=YPRED(I+2)-XN*YAMPT*X1RØ
     YDØT(I)  =XN*YANTH*X1RØ-XN*YAMTH*X1RØSQ-XFTHLD-XMPHLD*X1RØ
     YDØT (I+5) =(1.0/(XK22+XC22**2/XD22))*(YPRED(I+1)+XNTPH+(XC22/XD22
    1      )*(YPRED(I+3)+XMTPH)-(XK21*X1RØ)*(XN*YPRED(I+4)-YPRED
    2      (I+6))-(XC22*XD21/XD22)*(X1RØSQ*(XN*(YPRED(I+4)-XN*YPRE
    3      D(I+6)))))
     YDØT(I+1) = -XN*X1RØ*YPRED(I)-XN*YAMPT*X1RØSQ-XFPHLD-XNL*(XFPHLD*
    1           (YDØT(I+5)-YPRED(I+6)*X1RØ)-XFZELD*YPRED(I+7))
     YDØT(I+2) = -YANTH*X1RØ+XNSQ*YAMTH*X1RØSQ+XN*XMPHLD*X1RØ-XFZELD-
    1           XNL*(XFZELD*(YDØT(I+5)-YPRED(I+6)*X1RØ)+XFPHLD*YPRED(
    2           I+7))
     YDØT(I+3) = -2*XN*YAMPT*X1RØ+YAJPH+XMTHLD
     YDØT(I+4)=XN*YPRED(I+5)*X1RØ+YPRED(I)/XK33+YAMPT*X1RØ/XK33
     YDØT(I+6)=YPRED(I+7)
     YDØT(I+7)=-(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+XNTPH-XK21*X1RØ*
    9       (
    1       XN*YPRED(I+4)-YPRED(I+6)))+(XK22/(XC22**2+XK22*XD22))*(
    2       YPRED(I+3)+XMTPH)-(XK22*XD21/(XC22**2+XK22*XD22))*(
    3       X1RØSQ*(XN*YPRED(I+4)-XNSQ*YPRED(I+6)))
     YAQTH=(-1.0/((RØ/XD33)+(X1RØ/XK33)))*(-2.0*XN*YDØT(I+7)+XN*YDØT(I+
    1      5)*X1RØ+YDØT(I)/XK33)-XN*YAMTH*X1RØ-XMPHLD
     IF(XN.EQ.0.0.AND.XFTHLD.EQ.0.0.AND.XMPHLD.EQ.0.0)  YAQTH=0.0
9005 IY =8*(M-1)+1
     YASAVE(IY) = YANTH
     YASAVE(IY+1)=YAMTH
     YASAVE(IY+2)=YAMPT
     YASAVE(IY+3)=YANPT
     YASAVE(IY+4)=YAØPH
     YASAVE(IY+5)=YAQPH
     YASAVE(IY+6)=YAQTH
     YASAVE(IY+7) = YAJPH
     RETURN
      END
```

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FØR,IS ØDE2,ØDE2
      SUBRØUTINE ØDE2                                                   2100030
      INTEGER SAVJTC,SAVSTP,Q,THICK
      CØMMØN STØRY(16),TALE(16),XMAT(110,10),STD(10),SADUS(30),RADUS(30) 2100050
      CØMMØN TADUS(30),UADUS(30),SAVTIC(900)                            2100060
      CØMMØN XN,TEFREE,TIC,PHI,STØP,RESTØP,RTICK,G1,XNL                 2100070
      CØMMØN NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)  2100080
      CØMMØN JRSTØP(30),NREG,NSEGTL,NMPT,MATPRP,NCUPLE,NRGEND,NSYM,NRG  2100090
      CØMMØN NRC,NSC,NIX,IERRØR,IØUT,MAT,KGEØM,IGEØM,ITYPE,ISTTAB,KELVIN 2100100
      CØMMØN IBEGIN,NPRØB,NHARM,NSEG,NERRØR, Q ,NSMAX,THICK             2100110
      EQUIVALENCE (XMTTH,XMTETH),(XMTPH,XMTEPH),(XNTTH,XNTETH),         2100130
     1            (XNTPH,XNTEPH)                                        2100140
      CØMMØN /LASTEQ/ YPRED( 80),YDØT( 80),YASAVE( 80),                 2100150
     1               YANTH,YAMTH,YAMPT,YANPT,YAØPH,YAQPH,YAQTH,YAJPH,   2100160
     2               S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,         2100170
     3               X1RØ,X1RØSQ,X1SNRØ,X1CSRØ,CN1RØ,SN1RØ,CS1RØ,       2100180
     4               X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RØ,BESQ,   2100190
     5   RØSQ,XNSQ,BETA,R1,R2,S1,R1DØT,R1SQ,                            2100200
     6               XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,      2100210
     7  XMTHLD,XMPHLD,ETHET(2),EPHI(2),XGPT(2),ALPHTH(2),ALPHPH(2),     2100220
     8               XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,    2100230
     9               XK11,XK12,XK21,XK22,XK33,XD11,                     2100240
     A                   M,I,SITIN,SITØUT,SIPIN,SIPØUT,TPTIN,TPTØUT,    2100250
     B            ZBRIN,ZBRØUT,SCRIPA,SCRIPI,SIFIN,SIFØUT,TZEPH,TZETH   2100260
     B , XNPHI,BETTA,XC16,XC14,XC25                                     2100270
      EQUIVALENCE  (XNPHI,XNPI)                                         2100280
      DØUBLE PRECISIØN YPRED                                            2100290
 7447 GØ TØ (7341,7342,7343),IGEØM                                      2100300
C     THE FØLLØWING EQUATIØNS ARE THE -RWAF- SET                        2100310
C     EQUATIØNS FØR SHELLS ØF REVØLUTIØN ( PHI CØØRDINATE )             2100320
 7341 YANTH = (YPRED(I+1)+XNTPH)*(XC15*XC22+XD22*XK12)/(XK22*XD22+
     1 XC22*XC22)-XNTTH+(XK12*XC22-XK22*XC15)*(YPRED(I+3)+XMTPH)/
     2 (XC22*XC22+XK22*XD22)+X1RØ*(XN*YPRED(I+4)+YPRED(I+5)*CS-
     3 YPRED(I+6)*SN)*(XK11+(XC15*(XC15*XK22-2.0*XK12*XC22)-XK12*XK12*    600370
     4 XD22)/(XK22*XD22+XC22*XC22))+(X1RØSQ*(XN*YPRED(I+4)*SN-XNSQ
     5 *YPRED(I+6))+X1RØ*YPRED(I+7)*CS)*(-XC11+(XC15*XC15*XC22+
     6 XC15*(XK12*XD22+XK22*XD12)-XK12*XD12*XC22)/(XK22*XD22+XC22*XC22))  600400
      YAMTH = (YPRED(I+3)+XNTPH)*(XC15*XC22+XK22*XD12)/(XK22*XD22+
     1 XC22*XC22)+(YPRED(I+1)+XNTPH)*(XD22*XC15-XD12*XC22)/(XD22*XK22+    600420
     2 XC22*XC22)-XMTTH+(X1RØSQ*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+
     3 X1RØ*YPRED(I+7)*CS)*(XD11-(XD12*XD12*XK22+XC15*(2.0*XC22*XD12-
     3 XC15*
     4 XD22))/(XC22*XC22+XK22*XD22))+X1RØ*(XN*YPRED(I+4)+YPRED(I+5)*CS-   600450
     5 YPRED(I+6)*SN)*(XC11+(XD12*XC22*XK12-XC15*(XC15*XC22+XD12*XK22+    600460
     6 XD22*XK12))/(XC22*XC22+XK22*XD22))                                 600470
      YAMPT = (1.0/(XC16*SN*X1RØ-XK33-SN*X1RØ*(XD33*SN/(     RØ)-XC16))) 2100470
     1        *((XK33*XD33-XC16**2)*X1RØ*(-2.0*XN*YPRED(I+7)+YPRED(I+4)* 2100480
     2        (CS*X1R1-CN1RØ)+XN*YPRED(I+5)*(X1R1+SN1RØ)+2.0*XN*YPRED    2100490
     3        (I+6)*CS*X1RØ)+YPRED(I)*(XD33*SN*X1RØ-XC16))               2100500
      YAJPH = YPRED(I+2)-XNL*(XNPI*YPRED(I+7))                          2100510
      YANPT=YPRED(I)+YAMPT*SN1RØ                                        2100520
      YAØPH=XN*YPRED(I+6)*X1RØ-YPRED(I+4)*SN1RØ                         2100530
      YAQPH=YPRED(I+2)-XN*YAMPT*X1RØ                                    2100540
      YDØT(I)=R1*(-2.0*YPRED(I)*CS1RØ+XN*YANTH*X1RØ-XN*YAMTH*SN*X1RØSQ- 2100550
     1        YAMPT*CS1RØ*(X1R1-SN1RØ)-XFTHLD-XMPHLD*SN1RØ)             2100560
      YDØT(I+5)=YPRED(I+6)+R1*(XD22*(YPRED(I+1)+XNTPH)+XC22*(YPRED(I+3) 2100570
     1+XMTPH)-X1RØ*(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)*(XK12*   2100580
     2XD22+XC15*XC22)-(X1RØSQ*(XN*YPRED(I+4)-XNSQ*YPRED(I+6))+X1RØ*     2100590
     3YPRED(I+7)*CS)*(XC22*XD12-XC15*XD22))/(XK22*XD22+XC22**2)         2100600
      YDØT(I+1) =(-YPRED(I+1)*CS1RØ+YANTH*CS1RØ-XN*YPRED(I)*X1RØ-XN*    2100610
     1          YAMPT*X1RØ*(SN*X1RØ+X1R1)+YPRED(I+2)*X1R1-XFPHLD-       2100620
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2             XNL*(XFPHLD*(YPRED(I+5)*CS1RØ-YPRED(I+6)*(X1R1+SN1RØ)
3             +YDØT (I+5)*X1R1)-XFZELD*YPRED(I+7)))*R1
  YDØT(I+2) =(-YAJPH*CS*X1RØ-YANTH*SN1RØ-YPRED(I+1)*X1R1+XNSQ*YAMTH*
1            X1RØSQ-2.0*XN*YAMPT*CS*X1RØSQ+XN*XMPHLD*X1RØ-XFZELD-XNL
2           *(XFZELD*(YPRED(I+5)*CS*X1RØ-YPRED(I+6)*(X1R1+SN1RØ)+
3            YDØT (I+5)*X1R1)+XFPHLD*YPRED(I+7))-XNL*CS1RØ*(XNPI*
4            YPRED(I+7)))*R1
  YDØT(I+3) = R1*(YAMTH*CS1RØ-YPRED(I+3)*CS1RØ-2.0*XN*YAMPT*X1RØ+
1             YAJPH+XMTHLD)
  YDØT(I+4) =R1*(YPRED(I+4)*CS*X1RØ+XN*YPRED(I+5)*X1RØ+(1.0/(XK33-
1            XC16**2/XD33))*(YPRED(I)+YAMPT*(SN*X1RØ-XC16/XD33)))
  YDØT(I+6)=R1*(YPRED(I+7)-YPRED(I+5)*X1R1)
  YDØT(I+7)=R1*(XK22*(YPRED(I+3)+XMTPH)-XC22*(YPRED(I+1)+XNTPH)+X1RØ
 1*(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)*(XK12*XC22-XK22*XC15)
 2-(X1RØSQ*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+X1RØ*YPRED(I+7)*CS)*
 3(XC15*XC22+XK22*XD12))/(XC22**2+XK22*XD22)
  YAQTH=(4.*CS1RØ-((2.*CS*(XC16*RØ*X1R1+XC16*SN-RØ*XK33-SN1R1*XD33))
1     /(2.*RØ*XC16*SN-RØSQ*XK33-XD33*SNSQ)))*YAMPT+(X1R1/(2.*XC16*
2     SN1RØ-XK33-XD33*SNSQ*X1RØSQ))*((XK33*XD33-XC16**2)*(-2.*XN*
3     YDØT(I+7)*X1RØ+2.*XN*YPRED(I+7)*R1*CS*X1RØSQ+YDØT(I+4)*(
4     CS1R1*X1RØ-CN1RØ*X1RØ)+YPRED(I+4)*(-SN1R1*X1RØ-(CS*(RØ*R1DØT
5     +R1SQ*CS))/(R1SQ*RØSQ)-(CSSQ-SNSQ)*X1RØSQ+2.*R1*CSSQ*SN*X1RØ
6     *X1RØSQ)+XN*YDØT(I+5)*(X1RØ*X1R1+SN1RØ*X1RØ)+XN*YPRED(I+5)
7   *(-2.*R1*CN1RØ*X1RØSQ-R1DØT*X1R1SQ*X1RØ)+2.*XN*YDØT(I+6)*
8     CS*X1RØSQ-2.*XN*YPRED(I+6)*(SN1RØ*X1RØ+2.*R1*CSSQ*X1RØ*X1RØSQ)
9     )+YDØT(I)*(XD33*SN1RØ-XC16)+YPRED(I)*(XD33*CS1RØ-XD33*R1*
A     CN1RØ*X1RØ))-XN*YAMTH*X1RØ-XMPHLD
  IF(XN.EQ.0.0.AND.XFTHLD.EQ.0.0.AND.XMPHLD.EQ.0.0)  YAQTH=0.0
  GØ TØ 9005
C     EQUATIØNS FØR CØNE
 7342 YANTH = (YPRED(I+1)+XNTPH)*(XC15*XC22+XD22*XK12)/(XK22*XD22+
    1 XC22*XC22)-XNTTH+(XK12*XC22-XK22*XC15)*(YPRED(I+3)+XMTPH)/
    2 (XC22*XC22+XK22*XD22)+(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)
    3 *SN)/(S*CS)*(XK11+(XC15*(XC15*XK22-2.0*XK12*XC22)-XK12*XK12*        600
    4 XD22)/(XK22*XD22+XC22*XC22))+((XN*YPRED(I+4)*SN-XNSQ*
    5 YPRED(I+6))/(S*S*CSSQ)+YPRED(I+7)/S)*(-XC11+(XC15*XC15*XC22+
    6 XC15*(XK12*XD22+XK22*XD12)-XK12*XD12*XC22)/(XK22*XD22+XC22*XC22))
      YAMTH = (YPRED(I+3)+XNTPH)*(XC15*XC22+XK22*XD12)/(XK22*XD22+
    1 XC22*XC22)+(YPRED(I+1)+XNTPH)*(XD22*XC15-XD12*XC22)/(XD22*XK22+
    2 XC22*XC22)-XMTTH+(1.0/(S*S*CSSQ)*(-XNSQ*YPRED(I+6)+XN*YPRED(I+4)*
    3 SN)+YPRED(I+7)/S)*(XD11-(XD12*XD12*XK22+XC15*(2.0*XC22*XD12-XC15*
    4 XD22))/(XC22*XC22+XK22*XD22))+1.0/(S*CS)*(XN*YPRED(I+4)+
    5 YPRED(I+5)*CS-
    5 YPRED(I+6)*SN)*(XC11+(XD12*XC22*XK12-XC15*(XC15*XC22+XD12*XK22+
    6 XD22*XK12))/(XC22*XC22+XK22*XD22))
  YAMPT =((XC16*TAN/S-XK33-(TAN/S)*(XD33*TAN/S-XC16))**(-1))*((XK33*
1         XD33-XC16**2)*(1.0/(S*CS))*(-2.0*XN*YPRED(I+7)-YPRED(I+4)*
2           SN/S+XN*YPRED(I+5)*TAN/S+2.0*XN*YPRED(I+6)/S)+YPRED(I)*(
3         XD33*TAN/S-XC16))
  YAJPH = YPRED(I+2)-XNL*(XNPHI*YPRED(I+7))
  YANPT=YPRED(I)+YAMPT*TN/S
  YAØPH=XN*YPRED(I+6)*X1CS/S-YPRED(I+4)*TN/S
  YAQPH=YPRED(I+2)-XN*YAMPT*X1CS/S
  YDØT(I)   =-2.0*YPRED(I)/S+XN*YANTH*X1CS/S-XN*YAMTH*SN*X1CS**2/S**2
1            +YAMPT*TN/S**2-XFTHLD-XMPHLD*TN/S
  YDØT(I+5)=(XD22*(YPRED(I+1)+XNTPH)+XC22*(YPRED(I+3)+XMTPH)-(XK12*
1           XD22+XC15*XC22)*(1.0/(S*CS)*(XN*YPRED(I+4)+YPRED(I+5)*
2           CS-YPRED(I+6)*SN))-(XC22*XD12-XC15*XD22)*((-XNSQ*
3           YPRED(I+6)+XN*YPRED(I+4)*SN)/(S*S*CSSQ)+YPRED(I+7)/S))
4           /(XK22*XD22+XC22*XC22)
  YDØT(I+1)= -YPRED(I+1)/S+YANTH/S-XN*YPRED(I)/(S*CS)-XN*YAMPT*SN/
```

```
     1            (S**2*CS**2)-XFPHLD-XNL*(XFPHLD*(YPRED(I+5)/S-YPRED     2101250
     2            (I+6)*TAN/S+YDØT(I+5))-XFZELD*YPRED(I+7))              2101260
      YDØT(I+2)= -YAJPH/S-YANTH*TAN/S+XNSQ*YAMTH/(S**2*CS**2)-2.0*XN*     2101270
     1          YAMPT/(S**2*CS)+XN*XMPHLD/(S*CS)-XFZELD-XNL*(XFZELD*(     2101280
     2            YPRED(I+5)/S-YPRED(I+6)*TAN/S+YDØT(I+5))+XFPHLD*YPRED  2101290
     3           (I+7))-XNL*XNPHI*YPRED(I+7)/S                           2101300
      YDØT(I+3)= YAMTH/S-YPRED(I+3)/S-2.0*XN*YAMPT/(S*CS)+YAJPH+XMTHLD   2101310
      YDØT (I+4) = YPRED(I+4)/S+XN*YPRED(I+5)/(S*CS)+(1.0/(XK33-XC16**2/ 2101320
     1             XD33))*(YPRED(I)+YAMPT*(TAN/S-XC16/XD33))              2101330
      YDØT(I+6)=YPRED(I+7)                                               2101340
      YDØT(I+7)=(XK22*(YPRED(I+3)+XMTPH)-XC22*(YPRED(I+1)+XNTPH)+        2101350
     1          (XK12*XC22-XK22*XC15)*(1.0/(S*CS)*(XN*YPRED(I+4)+        2101360
     2          YPRED(I+5)*CS-YPRED(I+6)*SN))-(XC15*XC22+XK22*XD12)*     2101370
     3          ((-XNSQ*YPRED(I+6)+XN*YPRED(I+4)*SN)/(S*S*CSSQ)+         2101380
     4          YPRED(I+7)/S))/(XK22*XD22+XC22*XC22)                     2101390
      YAQTH=(4./S-(2.*CS*(XC16*SN-S*XK33*CS))/(2.*S*XC16*CS*SN-S*S*XK33* 2101400
     1CSSQ-XD33*SNSQ))*YAMPT+(1./(2.*XC16*TAN*S1-XK33-XD33*TAN**2       2101410
     2*S1**2))*((XK33*XD33-XC16**2)*(((-2.*XN)/(S*CS))*YDØT(I+7)         2101420
     3+(2.*XN*YPRED(I+7))/(S**2*CS)-YDØT(I+4)*(TAN*S1**2)+YPRED(I+4     2101430
     4 )*(2.*TAN/S**3)+XN*YDØT(I+5)*(TAN/(S**2*CS))-XN*YPRED(I+5)*((2.  2101440
     5*TAN)/(S**3*CS))+YDØT(I+6)*((2.*XN)/(S**2*CS))-2.*XN*YPRED(I+6)    2101450
     6*(2./(S**3*CS)))+YDØT(I)*(XD33*TAN*S1-XC16)-YPRED(I)*((XD33        2101460
     7        *TAN)/(S**2)))  -(XN*YAMTH)/(S*CS)-XMPHLD                  2101470
       IF(XN.EQ.0.0.AND.XFTHLD.EQ.0.0.AND.XMPHLD.EQ.0.0)  YAQTH=0.0      2101480
       GØ TØ 9005                                                        2101490
C      EQUATIØNS FØR CYLINDER                                            2101500
 7343 YANTH = (YPRED(I+1)+XNTPH)*(XC15*XC22+XD22*XK12)/(XK22*XD22+
     1 XC22*XC22)-XNTTH+(XK12*XC22-XK22*XC15)*(YPRED(I+3)+XMTPH)/
     2 (XC22*XC22+XK22*XD22)+X1RØ*(XN*YPRED(I+4)-
     3 YPRED(I+6))*(XK11+(XC15*(XC15*XK22-2.0*XK12*XC22)-XK12*XK12*       601280
     4 XD22)/(XK22*XD22+XC22*XC22))+(X1RØSQ*(XN*YPRED(I+4)-XNSQ           601290
     5 *YPRED(I+6)))*(-XC11+(XC15*XC15*XC22+
     6 XC15*(XK12*XD22+XK22*XD12)-XK12*XD12*XC22)/(XK22*XD22+XC22*XC22))
      YAMTH = (YPRED(I+3)+XNTPH)*(XC15*XC22+XK22*XD12)/(XK22*XD22+
     1 XC22*XC22)+(YPRED(I+1)+XNTPH)*(XD22*XC15-XD12*XC22)/(XD22*XK22+
     2 XC22*XC22)-XMTTH+X1RØSQ*(XN*YPRED(I+4)-XNSQ*YPRED(I+6))
     3 *(XD11-(XD12*XD12*XK22+XC15*(2.0*XC22*XD12-XC15*
     4 XD22))/(XC22*XC22+XK22*XD22))+X1RØ*(XN*YPRED(I+4)-
     5 YPRED(I+6))*(XC11+(XD12*XC22*XK12-XC15*(XC15*XC22+XD12*XK22+       601370
     6 XD22*XK12))/(XC22*XC22+XK22*XD22))
      YAMPT=(1/(XC16*X1RØ-XK33-X1RØ*(XD33*X1RØ-XC16)))*((XK33*XD33-XC16  2101650
     1        **2)*X1RØ*(-2*XN*YPRED(I+7)+XN*X1RØ*YPRED(I+5))+YPRED(I)*(  2101660
     2        XD33*X1RØ-XC16))                                           2101670
      YAJPH = YPRED(I+2) - XNL * (XNPHI*YPRED(I+7))                      2101680
      YANPT=YPRED(I)+YAMPT*X1RØ                                          2101690
      YAØPH=X1RØ*(XN*YPRED(I+6)-YPRED(I+4))                              2101700
      YAQPH=YPRED(I+2)-XN*YAMPT*X1RØ                                     2101710
      YDØT(I)  =XN*YANTH*X1RØ-XN*YAMTH*X1RØSQ-XFTHLD-XMPHLD*X1RØ         2101720
      YDØT(I+5)=(XD22*(YPRED(I+1)+XNTPH)+XC22*(YPRED(I+3)+XMTPH)-X1RØ*   2101730
     1(XN*YPRED(I+4)-YPRED(I+6))*(XK12*XD22+XC15*XC22)-X1RØSQ*(XN*YPRED  2101740
     2(I+4)-XNSQ*YPRED(I+6))*(XC22*XD12-XC15*XD22))/(XK22*XD22+XC22**2)  2101750
      YDØT(I+1) = -XN*X1RØ*YPRED(I)-XN*YAMPT*X1RØSQ-XFPHLD-XNL*(XFPHLD*  2101760
     1             (YDØT(I+5)-YPRED(I+6)*X1RØ)-XFZELD*YPRED(I+7))        2101770
      YDØT(I+2) = -YANTH*X1RØ+XNSQ*YAMTH*X1RØSQ+XN*XMPHLD*X1RØ-XFZELD-   2101780
     1            XNL*(XFZELD*(YDØT(I+5)-YPRED(I+6)*X1RØ)+XFPHLD*YPRED(  2101790
     2            I+7))                                                  2101800
      YDØT(I+3) = -2*XN*YAMPT*X1RØ+YAJPH+XMTHLD                          2101810
      YDØT(I+4)=(XN*YPRED(I+5)/RØ)+(1/(XK33-XC16**2/XD33))*(YPRED(I)+    2101820
     1          YAMPT*(X1RØ-XC16/XD33))                                  2101830
      YDØT(I+6)=YPRED(I+7)                                               2101840
      YDØT(I+7)=(XK22*(YPRED(I+3)+XMTPH)-XC22*(YPRED(I+1)+XNTPH)+X1RØ*   2101850
```

```
     1(XN*YPRED(I+4)-YPRED(I+6))*(XK12*XC22-XK22*XC15)-X1RØSQ*(XN*YPRED
     2(I+4)-XNSQ*YPRED(I+6))*(XC15*XC22+XK22*XD12))/(XC22**2+XK22*XD22)
      YAQTH=(1./(2.*XC16*X1RØ-XK33-XD33*X1RØSQ))*((XK33*XD33-XC16**2)*
     9  X1RØ
     1  *(-2.*XN*YDØT(I+7)+XN*X1RØ*YDØT(I+5))+YDØT(I)*(XD33*X1RØ-
     2      XC16))-XN*X1RØ*YAMTH-XMPHLD
      IF(XN.EQ.0.0.AND.XFTHLD.EQ.0.0.AND.XMPHLD.EQ.0.0)  YAQTH=0.0
9005  IY =8*(M-1)+1
      YASAVE(IY) = YANTH
      YASAVE(IY+1)=YAMTH
      YASAVE(IY+2)=YAMPT
      YASAVE(IY+3)=YANPT
      YASAVE(IY+4)=YAØPH
      YASAVE(IY+5)=YAQPH
      YASAVE(IY+6)=YAQTH
      YASAVE(IY+7) = YAJPH
      RETURN
       END
```

SUBROUTINE OUTPUT

Subroutine OUTPUT is called from LEBEGE and stress resultants, deformations, and geometric data are passed to the subroutine in the label common area LASTEQ. The routine OUTPUT calculates stresses and strains, and sums these in a Fourier series for given angles, in a multi-harmonic submission.

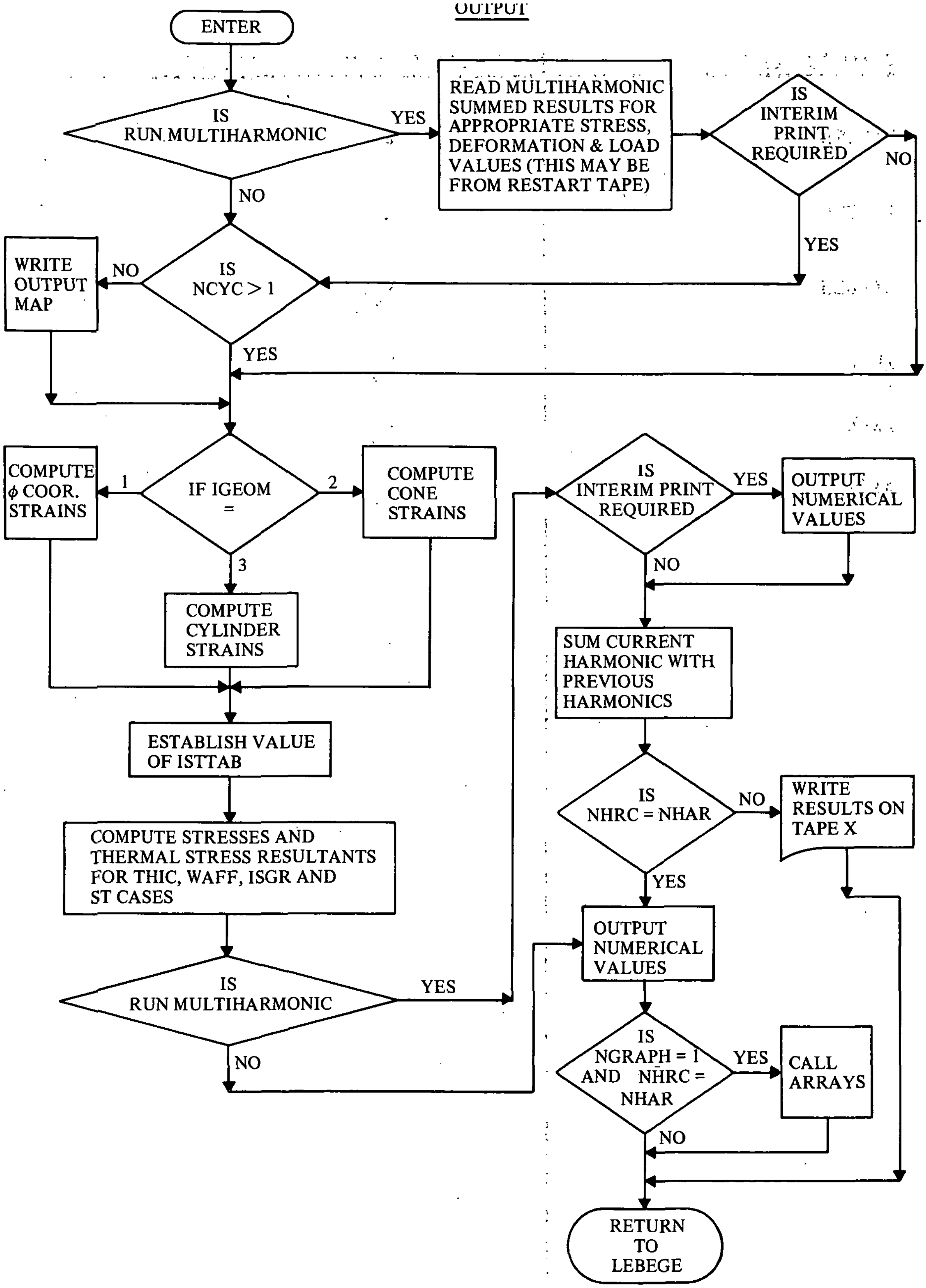
The final program printing, both with and without intermediate result requiremei is done in the OUTPUT subroutine. OUTPUT also creates any necessary restart ta;

Subroutine ARRAYS:

If the clues are set for graphical display of results, the necessary informatioi is passed to this subroutine, which in turn rearranges the information to be plotted into proper arrays.

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
SITIN	$\sigma_{\theta_{in}}$
SITOUT	$\sigma_{\theta_{out}}$
SIPIN	$\sigma_{\phi_{in}}$
SIPOUT	$\sigma_{\phi_{out}}$
TPTIN	$\tau_{\phi\theta_{in}}$
TPTOUT	$\tau_{\phi\theta_{out}}$
ZBRIN	$\bar{\zeta}_{in}$
ZBROUT	$\bar{\zeta}_{out}$
SCRIPA	$\mathcal{A}$
SCRIPI	$\mathcal{I}$
SIFIN	$\sigma_{F_{in}}$
SIFOUT	$\sigma_{F_{out}}$
TZEPH	$\tau_{\zeta\phi}$
TZETH	$\tau_{\zeta\theta}$

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
EPSITH	ε_{θ_o}
EPSIPH	ε_{ϕ_o}
GAPHTH	$\gamma_{\phi\theta_o}$
XKTH	k_θ
XKPH	k_ϕ
XKPT	$k_{\phi\theta}$


ENTER
IS RUN MULTIHARMONIC
YES
NO
READ MULTIHARMONIC SUMMED RESULTS FOR APPROPRIATE STRESS, DEFORMATION & LOAD VALUES (THIS MAY BE FROM RESTART TAPE)
IS INTERIM PRINT REQUIRED
NO
YES
WRITE OUTPUT MAP
NO
IS NCYC > 1
YES
COMPUTE φ COOR. STRAINS
1
IF IGEOM =
2
COMPUTE CONE STRAINS
3
COMPUTE CYLINDER STRAINS
ESTABLISH VALUE OF ISTTAB
COMPUTE STRESSES AND THERMAL STRESS RESULTANTS FOR THIC, WAFF, ISGR AND ST CASES
IS RUN MULTIHARMONIC
YES
NO
IS INTERIM PRINT REQUIRED
YES
OUTPUT NUMERICAL VALUES
NO
SUM CURRENT HARMONIC WITH PREVIOUS HARMONICS
IS NHRC = NHAR
NO
WRITE RESULTS ON TAPE X
YES
OUTPUT NUMERICAL VALUES
IS NGRAPH = 1 AND NHRC = NHAR
YES
CALL ARRAYS
NO
RETURN TO LEBEGE

```
FØR,IS ØUTPUT,ØUTPUT
      SUBRØUTINE ØUTPUT  (KLUE,YCØRR,ER,ES,ALPHR,ALPHS,ZINTH,            2200030
     1        ZØUTTH,ZINPH,ZØUTPH,NCYC,TIME,DEGRES,DTA,STEP,             2200040
     2 HI,HØ,T,TII,TØØ,THK,TIK,TØK,RØ2,E1,E2  )                          2200050
      INTEGER SAVJTC,SAVSTP,Q,THICK
      CØMMØN STØRY(16),TALE(16),XMAT(110,10),STD(10),SADUS(30),RADUS(30) 2200070
      CØMMØN TADUS(30),UADUS(30),SAVTIC(900)                             2200080
      CØMMØN XN,TEFREE,TIC,PHI,STØP,RESTØP,RTICK,G1,XNL                  2200090
      CØMMØN NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)   2200100
      CØMMØN JRSTØP(30),NREG,NSEGTL,NMPT,MATPRP,NCUPLE,NRGEND,NSYM,NRG   2200110
      CØMMØN NRC,NSC,NIX,IERRØR,IØUT,MAT,KGEØM,IGEØM,ITYPE,ISTTAB,KELVIN 2200120
      CØMMØN IBEGIN,NPRØB,NHARM,NSEG,NERRØR, Q ,NSMAX,THICK              2200130
      EQUIVALENCE (XMTTH,XMTETH),(XMTPH,XMTEPH),(XNTTH,XNTETH),          2200140
     1             (XNTPH,XNTEPH)                                        2200150
      EQUIVALENCE  (XNPHI,XNPI)                                          2200160
      DIMENSIØN KLUE(4)                                                  2200170
      DIMENSIØN YCØRR(80)                                                2200210
      DIMENSIØN SLSUM(30),ASAVE(30)                                      2200230
      DØUBLE PRECISIØN YPRED
      CØMMØN /LASTEQ/ YPRED( 80),YDØT( 80),YASAVE( 80),                  2200250
     1                YANTH,YAMTH,YAMPT,YANPT,YAØPH,YAQPH,YAQTH,YAJPH,   2200260
     2                S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,         2200270
     3                X1RØ,X1RØSQ,X1SNRØ,X1CSRØ,CN1RØ,SN1RØ,CS1RØ,       2200280
     4                X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RØ,BESQ,   2200290
     5    RØSQ,XNSQ,BETA,R1,R2,S1,R1DØT,R1SQ,                            2200300
     6                XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,      2200310
     7  XMTHLD,XMPHLD,ETHET(2),EPHI(2),XGPT(2),ALPHTH(2),ALPHPH(2),      2200320
     8                XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,    2200330
     9                XK11,XK12,XK21,XK22,XK33,XD11,                     2200340
     A                  M,I,SITIN,SITØUT,SIPIN,SIPØUT,TPTIN,TPTØUT,      2200350
     B             ZBRIN,ZBRØUT,SCRIPA,SCRIPI,SIFIN,SIFØUT,TZEPH,TZETH   2200360
     B , XNPHI,BETTA,XC16,XC14,XC25                                      2200370
      CØMMØN/HARMØN/ NHRC,IRCNT, HARM(25), HARPØS(25),                   2200380
     1IHCLUE(2),THEANG(36),NANG,LUNSUM,LUN1,ISWICH,NUMØUT                2200390
     2,NHAR                                                              2200400
      INTEGER HARPØS                                                     2200410
 1726 FØRMAT(1H1)                                                        2200420
C  ØUTPUT  MUST  BE  CØMPILED  IN   ØPT=0                                2200430
      CØMMØN /RABBIT/ X(100),Y(100,56),LDEF(11),LANG(36),JCYC,INDEX,     2200440
     1        NØANG,NØCØRD,NGRAPH,NFLAG,LFLAG,KGM,JAM,JNSC               2200450
      INDEX = 0                                                          2200460
      JCYC = JCYC+1                                                      2200470
      X(JCYC) = PHI                                                      2200490
      KGM = KGEØM                                                        2200530
      NØUTD = NPRØB                                                      2200540
      NSUM = 27
      IF(NHAR .NE. 1)NØUTD = NANG                                        2200560
      IF(ISTTAB.LT.4 .ØR.ISTTAB.GT.9)GØ TØ 101                           2200570
      SNB = SIN(BETTA)                                                   2200580
      CSB = CØS(BETTA)                                                   2200590
      SNSQB = SNB*SNB                                                    2200600
      CSSQB = CSB*CSB                                                    2200610
  101 IF(KELVIN .NE. 2)GØ TØ 102                                         2200620
      TII = 0.0                                                          2200630
      TØØ = 0.0                                                          2200640
      TIK = 0.                                                           2200650
      TØK = 0.                                                           2200660
C                                                                        2200670
C     CALCULATE SUMS IF MULTI HARMØNIC PRØBLEM                           2200680
C                                                                        2200690
  102 CØNTINUE                                                           2200700
```

```
      IF(NHAR .EQ. 1 .ØR. NHRC.NE. NHAR)GØ TØ 109
      DØ 108 I=1,8
      ASAVE(I) = YASAVE(I)
      ASAVE(I+8) = YCØRR(I)
      IF(I.GT. 4)GØ TØ 108
      ASAVE(I+16) = YDØT(I+4)
  108 CØNTINUE
      ASAVE(21)=TII
      ASAVE(22)=TØØ
      ASAVE(23)=TIK
      ASAVE(24) = TØK
      ASAVE(25) = TEFREE
  109 CØNTINUE
      DØ 164 IJ=1,NØUTD
      IF(NHAR .EQ. 1)GØ TØ 160
      DØ 103 LI=1,NSUM
      SLSUM(LI) = 0.
  103 CØNTINUE
      IF(NHAR .EQ. 1)GØ TØ 160
      IF(NHRC.NE.1)READ(LUNSUM)(SLSUM(JI),JI=1,NSUM      )
      AN = THEANG(IJ)
      HAN = AN*HARM(NHRC)
      CØH = CØS(HAN)
      SØH = SIN(HAN)
      DØ 106 LI=1,2
      SLSUM(LI) = SLSUM(LI) + (YASAVE(LI)*CØH)
  106 CØNTINUE
      SLSUM(3)=SLSUM(3)+YASAVE(3)*SØH
      SLSUM(4)=SLSUM(4)+YASAVE(5)*SØH
      SLSUM(5)=SLSUM(5)+YASAVE(6)*CØH
      SLSUM(6)=SLSUM(6)+YASAVE(7)*SØH
      SLSUM(7 )=SLSUM(7 )+YCØRR(1)*SØH
      SLSUM(8 )=SLSUM(8 )+YCØRR(2)*CØH
      SLSUM(9 )=SLSUM(9 )+YCØRR(3)*CØH
      SLSUM(10)=SLSUM(10)+YCØRR(4)*CØH
      SLSUM(11)=SLSUM(11)+YCØRR(5)*SØH
      DØ 115 LI = 6,8
      SLSUM(LI+6) = SLSUM(LI+6) + (YCØRR(LI)* CØH)
  115 CØNTINUE
      SLSUM(16) = SLSUM(16) + (YDØT(6) * CØH)
      SLSUM(17) = SLSUM(17) + (XN*YDØT(7)*SØH)
      SLSUM(18) = SLSUM(18) + (YDØT(8) * CØH)
      SLSUM(15) = SLSUM(15) + YDØT(5)*SØH
      SLSUM(19) = TII    * CØH + SLSUM(19)
      SLSUM(20) = TIK   *CØH + SLSUM(20)
      SLSUM(21) = TØK    * CØH + SLSUM(21)
      SLSUM(22) = TØØ    * CØH + SLSUM(22)
      SLSUM(23) = SLSUM(23) + (XN*YCØRR(5)*CØH)
      SLSUM(24) = SLSUM(24) + (XN*YCØRR(6)*SØH)
      SLSUM(25) = SLSUM(25) + (XNSQ*YCØRR(7)*CØH)
      SLSUM(26) = SLSUM(26) + (XN*YCØRR(8)*SØH)
      SLSUM(27) = TEFREE*CØH+SLSUM(27)
      WRITE(LUN1)(SLSUM(LJ),LJ=1,NSUM)
C
C
      IF (NHRC .EQ. NHAR)GØ TØ 160
      IF(IHCLUE(2) .EQ. 1)GØ TØ 140
      IF(NCYC .GT. 1)GØ TØ 140
      IF(IJ .GT. 1)GØ TØ 140
      WRITE(6,7005)
 7005 FØRMAT(/////)
```

```
      WRITE(6,7000)                                                      2201300
      WRITE(6,7010)                                                      2201310
 7010 FØRMAT(3X,21HU                    ,21HQ PHI                        2201320
     3        21HJ PHI                  ,21HJ PHI STAR                   2201330
     4        21HT PHI THETA            ,21HN TEMPERATURE THETA     /    2201340
     5     3X,21HV                      ,21HQ THETA                      2201350
     6        21HN THETA                ,21HN PHI                        2201360
     8        21HN PHI THETA            ,21HN TEMPERATURE PHI       /    2201370
     9     3X,21HW                      ,21HØMEGA THETA                  2201380
     A        21HM THETA                ,21HM PHI                        2201390
     B        21HM PHI THETA            ,21HM TENPERATURE THETA     /    2201400
     C     3X,21H                       ,21HØMEGA PHI                    2201410
     D        21H                       ,21H                             2201420
     E        21H                       ,21HM TEMPERATURE PHI      //)   2201430
  126 THK = 0.                                                           2201440
      GØ TØ (158,131,158,152,153,154,152,153,154,152,153,154),ISTTAB     2201450
  131 GØ TØ (152,153,154,158),THICK                                      2201460
  152 THK = HI                                                           2201470
      GØ TØ 158                                                          2201480
  153 THK = T+2.0*HI                                                     2201490
      GØ TØ 158                                                          2201500
  154 THK = T+HI+HØ                                                      2201510
  158 CØNTINUE                                                           2201520
      WRITE(6,7001)TIME,DEGRES ,DTA,STEP,RØ,THK,YCØRR(5),YASAVE(6),      2201530
     1YASAVE(8),YCØRR(3), YCØRR(1),XNTTH,YCØRR(6),YASAVE(7),YASAVE(1),   2201540
     2YCØRR(2),YASAVE(4),XNTPH,YCØRR(7),YCØRR(8),YASAVE(2),              2201550
     3 YCØRR(4),YASAVE(3),XMTTH                                          2201560
      WRITE(6,7012)YASAVE(5),XMTPH                                       2201570
 7012 FØRMAT(24X,E14.7,70X,E14.7,///)                                    2201580
      GØ TØ 140                                                          2201590
  160 IF (NCYC .GT. 1)GØ TØ 339                                          2201600
      TZEPH   = 0.0                                                      2201610
      TZETH   = 0.0                                                      2201620
      SITIN   = 0.0                                                      2201630
      SITØUT  = 0.0                                                      2201640
      SIPIN = 0.0                                                        2201650
      SIPØUT  = 0.0                                                      2201660
      TPTIN   = 0.0                                                      2201670
      TPTØUT  = 0.0                                                      2201680
      SIFIN   = 0.0                                                      2201690
      SIFØUT  = 0.0                                                      2201700
      EPSITH = 0.0                                                       2201710
      EPSIPH = 0.0                                                       2201720
      GAPHTH = 0.0                                                       2201730
      XKPH   = 0.0                                                       2201740
      XKTH   = 0.0                                                       2201750
      XKPT   = 0.0                                                       2201760
      IF(IJ .GT. 1)GØ TØ 339                                             2201770
      WRITE(6,7000)                                                      2201780
      WRITE(6,7020)                                                      2201790
 7000 FØRMAT(3X,17HPHI (RAD. ØR IN.),4X,7HDEGREES,14X,14HPRINT INTERVAL, 2201800
     17X,4HSTEP,17X,6HR ZERØ,15X,14HBASE THICKNESS    )                  2201810
 7020 FØRMAT(3X,21HEPSILØN THETA           ,21HEPSILØN PHI               2201820
     3        21HGAMMA PHI THETA        21HK PHI                         2201830
     4        21HK THETA                21HN TEMPERATURE THETA  /        2201840
     5     3X,21HU                      21HQ PHI                         2201850
     6        21HK PHI THETA            21HJ PHI STAR                    2201860
     7        21HT PHI THETA            21HN TEMPERATURE PHI    /        2201870
     8     3X,21HV                      21HJ PHI                         2201880
     9        21HN THETA                21HN PHI                         2201890
     A        21HN PHI THETA            21HM TEMPERATURE THETA  /        2201900
```

```
     B      3X,21HW                 21HQ THETA
     C         21HM THETA           21HM PHI
     D         21HM PHI THETA       21HM TEMPERATURE PHI      /
     E      3X,21HØMEGA THETA       21HTAU ZETA PHI = Q/T
     F         21HSIGMA THETA IN    21HSIGMA PHI IN
     G         21HTAU PHI THETA IN  21HSIGMA F IN             /
     H      3X,21HØMEGA PHI         21HTAU ZETA THETA = Q/T
     I         21HSIGMA THETA ØUT   21HSIGMA PHI ØUT
     J         21HTAU PHI THETA ØUT 21HSIGMA F ØUT            //)
  339 CØNTINUE
      IF(NHAR .EQ. 1)GØ TØ 352
      DØ 345 I = 1,3
      YASAVE(I) = SLSUM(I)
      YCØRR(I) = SLSUM(I+6)
  345 CØNTINUE
      DØ 346 I = 4,6
      YCØRR(I  ) = SLSUM(I+6)
      YASAVE(I+1) = SLSUM(I)
  346 CØNTINUE
      YCØRR(7) = SLSUM(13)
      YCØRR(8) = SLSUM(14)
      YASAVE(4) = YCØRR(1) + (YASAVE(3)*X1RØ*SN)
      YASAVE(8) = YCØRR(3)
      TII = SLSUM(19)
      TIK=SLSUM(20)
      TØK=SLSUM(21)
      TØØ=SLSUM(22)
      TEFREE = SLSUM(27)
      DØ 348 I = 1,2
      YDØT(I+4) = SLSUM(I+14)
  348 CØNTINUE
      YD7XN = SLSUM(17)
      YDØT(8) = SLSUM(18)
      YC5XN = SLSUM(23)
      YC6XN = SLSUM(24)
      YC7XN2= SLSUM(25)
      YC8XN = SLSUM(26)
  352 CØNTINUE
      IL = 1
      IA = 1
      LI = IJ
      IF(NHAR .NE. 1)GØ TØ 356
      IL =(LI-1)*8+1
      IA = IL
      YD7XN = YDØT(IL+6)*XN
      YC5XN = YCØRR(IL+4)*XN
      YC6XN = YCØRR(IL+5)*XN
      YC7XN2 = YCØRR(IL+6)*XNSQ
      YC8XN = YCØRR(IL+7)*XN
  356 GØ TØ (1781,1782,1783),IGEØM
C     PHI CØØRDINATE
 1781 EPSITH=X1RØ*(YC5XN+YCØRR(IL+5)*CS - YCØRR(IL+6)*SN)
      EPSIPH=X1R1*(YDØT(IL+5) - YCØRR(IL+6))
      GAPHTH = YDØT(IL+4)*X1R1 - (YC6XN + YCØRR(IL+4)*CS)*X1RØ
      XKPH = YDØT(IL+7)*X1R1
      XKTH = X1RØ*(YCØRR(IL+7)*CS + (YC5XN*SN-YC7XN2 ) *
     1       X1RØ)
      XKPT = X1RØ * 0.5*(2.0*YASAVE(IA+4)*CS- YC8XN + X1R1 * (
     1 YDØT(IL+4) * SN + YCØRR(IL+4) * CS - YD7XN ))
      GØ TØ 1785
C     CØNE
```

```
 1782 EPSITH = (1.0/(S*CS)) * (YC5XN+YCØRR(IL+5)*CS-SN*YCØRR(IL+6))
      EPSIPH= YDØT(IL+5)
      GAPHTH = YDØT(IL+4) - 1.0/(S*CS) * (YC6XN+CS * YCØRR(IL+4))
      XKPH  = YDØT(IL+7)
      XKTH = 1.0/(S*CS) * (YCØRR(IL+7) * CS + 1.0/(S*CS) * (SN*YC5XN
     1 - YC7XN2 ))
      XKPT = 1.0/(2.0*S*CS) * (2.0 * YASAVE(IA+4) * CS - YC8XN +
     1  YDØT(IL+4) * SN - YD7XN  )
      GØ TØ 1785
C     CYLINDER
 1783 EPSITH= X1RØ* (YC5XN - YCØRR(IL+6))
      EPSIPH= YDØT(IL+5)
      GAPHTH= YDØT(IL+4) - YC6XN * X1RØ
      XKPH  = YDØT(IL+7)
      XKTH = X1RØSQ*(YC5XN - YC7XN2)
      XKPT = 0.5*X1RØ * (-YC8XN+ YDØT(IL+4) - YD7XN)
 1785 CØNTINUE
C
      THK= 0.
      IF (ISTTAB.NE.2) GØ TØ 640
  621 GØ TØ (610,620,630,640),THICK
  610 THK= HI
      ZBRIN= HI/2.0
      ZBRØUT=HI/2.0
      GØ TØ 670
C
  620 THK= T + 2.0*HI
      GØ TØ 650
C
  630 THK= T+HØ+HI
  650 TZEPH=YASAVE(IA+5)/T
      TZETH=YASAVE(IA+6)/T
  670 SCRPA1=((1.0-XNUPT*XNUTP)*XK11)/ETHET(1)
      SCRPA2=((1.0-XNUPT*XNUTP)*XK11)/ETHET(2)
      SCRPI1=((1.0-XNUPT*XNUTP)*XD11)/ETHET(1)
      SCRPI2=((1.0-XNUPT*XNUTP)*XD11)/ETHET(2)
      SIPIN = YCØRR(IL+1)/SCRPA1+YCØRR(IL+3)*ZBRIN/SCRPI1
      SIPØUT = YCØRR(IL+1)/SCRPA2-YCØRR(IL+3)*ZBRØUT/SCRPI2
      SITIN= YASAVE(IA)/SCRPA1+YASAVE(IA+1)*ZBRIN/SCRPI1
      SITØUT=YASAVE(IA)/SCRPA2-YASAVE(IA+1)*ZBRØUT/SCRPI2
      TPTIN =YASAVE(IA+3)/SCRPA1+YASAVE(IA+2)*ZBRIN/SCRPI1
      TPTØUT = YASAVE(IA+3)/SCRPA2-YASAVE(IA+2)*ZBRØUT/SCRPI2
      SIFIN = SQRT(SITIN**2-SITIN*SIPIN+SIPIN**2+3.0*TPTIN**2)
      SIFØUT = SQRT(SITØUT**2-SITØUT*SIPØUT+SIPØUT**2+3.0*TPTØUT**2)
      GØ TØ 648
C
  640 CØNTINUE
      NCLUE = KLUE(1)
      GØ TØ (648,648,648,642,644,646,642,644,646,642,644,646),ISTTAB
  642 THK=HI
      GØ TØ 648
  644 THK= T+2.0*HI
      GØ TØ 648
  646 THK= T+ HI+HØ
  648 CØNTINUE
C
      IF (KELVIN.EQ.2.ØR.KELVIN.EQ.4) GØ TØ 714
C
  717 TEMP11= ALPHTH(1)+ XNUTP * ALPHPH(1)
      TEMP12= ALPHTH(2)+ XNUTP * ALPHPH(2)
      TEMP21= ALPHPH(1)+ XNUPT * ALPHTH(1)
```

```
      TEMP22= ALPHPH(2)+ XNUPT * ALPHTH(2)
      TEMP3 = 1-XNUPT*XNUTP
      TEMP4 = HI/4.0
      ETHK1=  ETHET(1)*TEMP11/TEMP3
      TEMP5 = HI**2/24.0
      ETHK2 = ETHET(2)*TEMP12/TEMP3
      TEMP61= TII+ TIK-2* TEFREE
      TEMP62= TØØ+ TØK-2* TEFREE
      TEMP71= 2.0* TII +TIK-3*TEFREE
      TEMP72= 2.0* TØØ +TØK-3*TEFREE
      EPHK1 = EPHI(1)*TEMP21/TEMP3
      EPHK2 = EPHI(2)*TEMP22/TEMP3
      GØ TØ (811,812,813,814),THICK
  811 XNTTH= ETHK1    *           TEMP4 * (TEMP61+ TEMP62)
      XNTPH= EPHK1    *           TEMP4 * (TEMP61 + TEMP62)
      XMTTH= ETHK1    *           TEMP5 * (TEMP71- TEMP72)
      XMTPH= EPHK1    *           TEMP5 * (TEMP71 - TEMP72)
      GØ TØ 50
  812 TI = (HI*(E2-E1)+2.0*E2*T)/(2.0*(E1+E2))
      TØ = (HI*(E1-E2)+2.0*E1*T)/(2.0*(E1+E2))
      TEMP8= HI/2.0
      XNTTH = ETHK1    *         TEMP8*TEMP61 + ETHK2    *        TEMP8*
     1TEMP62
      XNTPH = EPHK1    *         TEMP8*TEMP61 + EPHK2    *        TEMP8*
     1TEMP62
      XMTTH =(ETHK1 *  TEMP8 * (HI*TEMP71/3.0+ TI*TEMP61)) - (ETHK2 *
     1 TEMP8*(HI*TEMP72/3.0+TØ*TEMP62))
      XMTPH =(EPHK1 *  TEMP8 * (HI*TEMP71/3.0+ TI*TEMP61)) - (EPHK2 *
     1 TEMP8*(HI*TEMP72/3.0+TØ*TEMP62))
      GØ TØ 50
  813 TI = (E2*HØ**2-E1*HI**2+2.0*E2*HØ*T)/(2.0*(E1*HI+E2*HØ))
      TØ = (E1*HI**2-E2*HØ**2+2.0*E1*HI*T)/(2.0*(E1*HI+E2*HØ))
      XNTTH = ETHK1*0.5*(HI*TEMP61)+ETHK2*0.5*(HØ*TEMP62)
      XNTPH= EPHK1*0.5*(HI*TEMP61)+ EPHK2*0.5*(HØ*TEMP62)
      XMTTH = ETHK1*0.5*(HI**2*TEMP71/3.0+TI*HI*TEMP61)-ETHK2*0.5*(HØ
     1**2*TEMP72/3.+ TØ*HØ*TEMP62)
      XMTPH = EPHK1*0.5*(HI**2*TEMP71/3.0+TI*HI*TEMP61)-EPHK2*0.5*(HØ
     1**2*TEMP72/3.+ TØ*HØ*TEMP62)
      GØ TØ 50
  814 TEMP10=((-XK11*XD11)**.5)/(48.0**.5)
      TEM11 =((-XK22*XD22)**.5)/(48.0**.5)
      XNTTH =(XK11/4.0 *TEMP11)* TEMP61 + (XK11/4.0*TEMP12) * TEMP62
      XNTPH =(XK22/4.0 *TEMP21)* TEMP61 + (XK22/4.0*TEMP22) * TEMP62
      XMTTH =  TEMP10*(TEMP11*TEMP71 - TEMP12* TEMP72)
      XMTPH =  TEM11 *(TEMP21*TEMP71 - TEMP22* TEMP72)
  714 IF (ISTTAB.LE.3) GØ TØ 50
      GØ TØ (11,12,13,14,15),NCLUE
   11 IERRØR=11
      NERRØR=37
      GØ TØ 8888
C     PHI STRINGER INNER
   12 SIPIN = ES*(EPSIPH-ZINPH*XKPH-ALPHS*(TII-TEFREE))
      GØ TØ 20
C     PHI SHELL INNER
   13 SIPIN=(EPHI(1)/(1.0-XNUPT*XNUTP))*(EPSIPH+XNUPT*EPSITH-ZINPH*(XKPH
     1      +XNUPT*XKTH)-(ALPHPH(1)+XNUPT*ALPHTH(1))*(TII-TEFREE))
      TPTIN= XGPT(1)*(GAPHTH-2.0*ZINPH*XKPT)
      GØ TØ 20
C     PHI WAFF INNER
   14 CØNTINUE
      AT = ALPHR*(TII-TEFREE)
```

```
      SIPIN = ER*((EPSIPH-ZINPH*XKPH-AT)*SNB*SNB-(GAPHTH-2.0*ZINPH*
     1 XKPT)*SNB*CSB+(EPSITH-ZINPH*XKTH-AT)*CSB*CSB)
      GØ TØ 20
C
C     PHI ISGR INNER
C
   15 CØNTINUE
      TBETTA= 2.0* BETTA
      CS2B= CØS(TBETTA)
      AT = ALPHR*(TII-TEFREE)
      SIPIN= (ER*CSB/(2.0*SNB))*((1.+CS2B)*(EPSIPH-ZINPH*XKPH- AT) +
     1       (1.0-CS2B)*(EPSITH-ZINPH*XKTH-AT))
   20 NCLUE = KLUE(2)
      GØ TØ (21,22,23,24,25),NCLUE
   21 IERRØR = 21
      NERRØR = 38
      GØ TØ 8888
C     PHI STRINGER ØUTER
   22 SIPØUT = ES*(EPSIPH-ZØUTPH*XKPH-ALPHS*(TØØ-TEFREE))
      GØ TØ 30
C     PHI SHELL ØUTER
   23 SIPØUT= (EPHI(2)/(1.0-XNUPT*XNUTP))*(EPSIPH+XNUPT*EPSITH-ZØUTPH*
     1       (XKPH+XNUPT*XKTH)-(ALPHPH(2)+XNUPT*ALPHTH(2))*(TØØ-TEFREE))
      TPTØUT= XGPT(2)*(GAPHTH-2.0*ZØUTPH*XKPT)
      GØ TØ 30
C     PHI WAFF ØUTER
   24 CØNTINUE
      AT = ALPHR*(TØØ-TEFREE)
      SIPØUT = ER*((EPSIPH-ZØUTPH*XKPH-AT)*SNB*SNB-(GAPHTH-2.0*ZØUTPH*
     1 XKPT)*SNB*CSB+(EPSITH-ZØUTPH*XKTH-AT)*CSB*CSB)
      GØ TØ 30
C
C
C     PHI ISGR ØUTER
   25 CØNTINUE
      TBETTA= 2.0* BETTA
      CS2B= CØS(TBETTA)
      AT = ALPHR*(TØØ-TEFREE)
      SIPØUT=(ER*CSB/(2.0*SNB))*((1.+CS2B)*(EPSIPH-ZØUTPH*XKPH-AT)  +
     1       (1.0-CS2B)*(EPSITH-ZØUTPH*XKTH-AT))
   30 NCLUE = KLUE(3)
      GØ TØ (31,32,33,34,35),NCLUE
C     THETA RING INNER
   31 SITIN = ER*(EPSITH-ZINTH*XKTH-ALPHR*(TII-TEFREE))
      GØ TØ 40
   32 IERRØR = 32
      NERRØR = 39
      GØ TØ 8888
C     THETA SHEL INNER
   33 SITIN=(ETHET(1)/(1.0- XNUPT*XNUTP))*(EPSITH+XNUTP*EPSIPH-ZINTH*
     1       (XKTH+XNUTP*XKPH)-(ALPHTH(1)+XNUTP*ALPHPH(1))*(TII-TEFREE))
      GØ TØ 40
C     THETA WAFF INNER
   34 CØNTINUE
      AT = ALPHR*(TII-TEFREE)
      SITIN = ER*((EPSIPH-ZINPH*XKPH-AT)*CSB*CSB+(GAPHTH-2.0*ZINPH*
     1 XKPT)*SNB*CSB+(EPSITH-ZINPH*XKTH-AT)*SNB*SNB)
      GØ TØ 40
C
C     THETA ISGR INNER
C
```

```
   35 CØNTINUE                                                           2204370
      AT = ALPHR*(TII-TEFREE)
      TBETTA= 2.0* BETTA                                                 2204390
      CS2B= CØS(TBETTA)                                                  2204400
      SITIN =(ER/(2.0*CSB)) *((SNB*(1.+CS2B)*(EPSIPH-ZINPH*XKPH-AT))+    2204410
     1       (SNB-CS2B*SNB+2.)*(EPSITH-ZINPH*XKTH-AT))                   2204420
   40 NCLUE = KLUE(4)                                                    2204430
      GØ TØ (41,42,43,44,45),NCLUE                                       2204440
C     THETA RING ØUTER                                                   2204450
   41 SITØUT = ER*(EPSITH-ZØUTTH*XKTH-ALPHR*(TØØ-TEFREE))
      GØ TØ 50                                                           2204470
   42 IERRØR = 42                                                        2204480
      NERRØR = 40                                                        2204490
      GØ TØ 8888                                                         2204500
C     THETA SHEL ØUTER                                                   2204510
   43 SITØUT= (ETHET(2)/(1.0-XNUPT*XNUTP))*(EPSITH+XNUTP*EPSIPH-ZØUTTH*   2204520
     1       (XKTH+XNUTP*XKPH)-(ALPHTH(2)+XNUTP*ALPHPH(2))*(TØØ-TEFREE))
      GØ TØ 50                                                           2204540
C     THETA WAFF ØUTER                                                   2204550
   44 CØNTINUE                                                           2204560
      AT = ALPHR*(TØØ-TEFREE)
      SITØUT = ER*((EPSIPH-ZØUTPH*XKPH-AT)*CSB*CSB+(GAPHTH-2.0*ZØUTPH*   2204590
     1 XKPT)*SNB*CSB+(EPSITH-ZØUTPH*XKTH-AT)*SNB*SNB)                    2204600
      GØ TØ 50                                                           2204610
C                                                                        2204620
C     THETA ISGR ØUTER                                                   2204630
C                                                                        2204640
   45 CØNTINUE                                                           2204650
      TBETTA= 2.0* BETTA                                                 2204660
      CS2B= CØS(TBETTA)                                                  2204670
      AT = ALPHR*(TØØ-TEFREE)
      SITØUT=(ER/(2.0*CSB)) *((SNB*(1.+CS2B)*(EPSIPH-ZØUTPH*XKPH-AT))+   2204690
     1       (SNB-CS2B*SNB+2.)*(EPSITH-ZØUTPH*XKTH-AT))                  2204700
   50 CØNTINUE                                                           2204710
      IF(NHAR .EQ. 1)GØ TØ 7026                                          2204720
      WRITE(6,7023)THEANG(LI)                                            2204730
 7023 FØRMAT(//51X,-THETA ANGLE= -,F9.5,- RADIANS -// )                  2204740
      GØ TØ 7029                                                         2204750
 7026 WRITE(6,7002)LI                                                    2204760
 7002 FØRMAT(//58X,15HPRØBLEM NUMBER ,I2//)                              2204770
 7029 CØNTINUE                                                           2204780
      WRITE(6,7001)TIME,DEGRES,DTA,STEP,RØ,THK,EPSITH,EPSIPH,GAPHTH,     2204790
     1XKPH,XKTH,XNTTH,YCØRR(IL+4),YASAVE(IA+5),XKPT,YCØRR(IL+2),         2204800
     2YCØRR(IL),XNTPH,YCØRR(IL+5),YASAVE(IA+7),YASAVE(IA),YCØRR(IL+1),   2204810
     3YASAVE(IA+3),XMTTH,YCØRR(IL+6),YASAVE(IA+6),YASAVE(IA+1),          2204820
     4YCØRR(IL+3),YASAVE(IA+2),XMTPH,YCØRR(IL+7),TZEPH,SITIN,SIPIN,      2204830
     5TPTIN,SIFIN,YASAVE(IA+4),TZETH,SITØUT,SIPØUT,TPTØUT,SIFØUT         2204840
 7001 FØRMAT((3X,6(E14.7,7X)))                                           2204850
      IF (NGRAPH.EQ.0.ØR.NHRC.NE.NHAR) GØ TØ 140                         2204860
      IF (LANG(IJ).EQ.0) GØ TØ 140                                       2204870
      CALL ARRAYS (YCØRR(IL+4),YCØRR(IL+5),YCØRR(IL+6),TZEPH,SITIN,      2204880
     1           SIPIN,TPTIN,TZETH,SITØUT,SIPØUT,TPTØUT)                 2204890
  140 CØNTINUE                                                           2204900
      IF(NHAR.EQ. 1 .ØR. NHRC.NE. NHAR)GØ TØ 164                         2204910
      DØ 144 I = 1,8                                                     2204920
      YASAVE(I) = ASAVE(I)                                               2204930
      YCØRR(I) = ASAVE(I+8)                                              2204940
      IF(I.GT. 4)GØ TØ 144                                               2204950
      YDØT(I+4) = ASAVE(I+16)                                            2204960
  144 CØNTINUE                                                           2204970
      TII = ASAVE(21)                                                    2204980
```

```
      TØØ = ASAVE(22)
      TIK = ASAVE(23)
      TØK = ASAVE(24)
      TEFREE = ASAVE(25)
  164 CØNTINUE
      GØ TØ 9999
 8888 NIX = 1
 9999 RETURN
      END
```

```
FØR,IS ARRAYS,ARRAYS
      SUBRØUTINE ARRAYS (A,B,C,D,E,F,G,H,Ø,P,Q)
      CØMMØN /RABBIT/ X(100),Y(100,56),LDEF(11),LANG(36),JCYC,INDEX,
     1       NØANG,NØCØRD,NGRAPH,NFLAG,LFLAG,KGM,JAM,JNSC
      DIMENSIØN Z(11)
      Z(1) = A
      Z(2) = B
      Z(3) = C
      Z(4) = D
      Z(5) = E
      Z(6) = F
      Z(7) = G
      Z(8) = H
      Z(9) = Ø
      Z(10) = P
      Z(11) = Q
      DØ 100 J=1,11
      IF (LDEF(J).EQ.0) GØ TØ 100
      INDEX = INDEX+1
      Y(JCYC,INDEX) = Z(J)
  100 CØNTINUE
      RETURN
      END
```

SUBROUTINE GRAPH

This subroutine controls the system graphical routines. GRAPH prints the titles and passes the graphical display points to the necessary system routines, which utilize a Stromberg-Carlson 4020 plotter.

```
FØR,IS GRAPH,GRAPH
      SUBRØUTINE GRAPH (NPRØB)                                          3400010
      CØMMØN /RABBIT/ X(100),Y(100,56),LDEF(11),LANG(36),JCYC,INDEX,    3400020
     1        NØANG,NØCØRD,NGRAPH,NFLAG,LFLAG,KGM,JAM,JNSC              3400030
      CØMMØN /HARMØN/ NHRC,IRCNT,HARM(25),HARPØS(25),IHCLUE(2),         3400040
     1        THEANG(36),NANG,LUNSUM,LUN1,ISWICH,NUMØUT,NHAR            3400050
      INTEGER HARPØS                                                    3400060
      DIMENSIØN IDARY(22)
      DIMENSIØN YTITLE(12),YTIT(4,11),XTITLE(12)
      DATA YTITLE/12*-      -/
      DIMENSIØN TITLE(12),THETA(4),ALØAD(4)
      DIMENSIØN ALPHA(2)
      EXTERNAL TABLIV
      DATA TITLE/-REGIØN-,- NØ.= -,2*6H      ,-SEGMEN-,-T NØ.=-,
     1           6*6H      /
      DATA THETA/-THETA=-,2*6H      ,- RADS.-/
      DATA ALØAD/-   LØA-,-D CASE-,2*6H      /
      DATA YTIT/-U      -,3*-      -,
     1          -V      -,3*-      -,
     2          -W      -,3*-      -,
     3          -TAU ZE-,-TA PHI-,- = Q/T-,-      -,
     4          -SIGMA -,-THETA -,-IN    -,-      -,
     5          -SIGMA -,-PHI IN-,-      -,-      -,
     6          -TAU PH-,-I THET-,-A IN  -,-      -,
     7          -TAU ZE-,-TA THE-,-TA = Q-,-/T    -,
     8          -SIGMA -,-THETA -,-ØUT   -,-      -,
     9          -SIGMA -,-PHI ØU-,-T     -,-      -,
     A          -TAU PH-,-I THET-,-A ØUT -,-      -/
      DATA XTITLE/-DISTAN-,-CE ALØ-,-NG SEG-,-MENT (-/
      DATA A/-PHI)-/,B/-S)  -/                                          3400100
      IF (NFLAG.NE.0) GØ TØ 1                                           3400180
      CALL IDENT (9,IDARY)
      NFLAG = 1                                                         3400200
    1 CØNTINUE                                                          3400210
      CALL CHSIZV(2,2)
      CALL RITSTV (13,19,TABLIV)
      XMN = X(1)
      XMX = X(1)
      DØ 20 J=1,JCYC
      IF (X(J).LT.XMN) XMN = X(J)
      IF (X(J).GT.XMX) XMX = X(J)
   20 CØNTINUE
      CALL SCRND (XMX,XMN,XMAX,XMIN)
      INDEX = 0                                                         3400250
      LIMIT = NANG                                                      3400260
      IF (NHAR.EQ.1) LIMIT = NPRØB                                      3400270
      DØ 100 J=1,LIMIT                                                  3400280
      IF (LANG(J).EQ.0) GØ TØ 100                                       3400290
      DØ 101 K=1,11                                                     3400300
      IF (LDEF(K).EQ.0) GØ TØ 101                                       3400310
      INDEX = INDEX+1                                                   3400320
      YMN = Y(1,INDEX)
      YMX = Y(1,INDEX)
      DØ 30 L=1,JCYC
      IF(Y(L,INDEX).LT.YMN) YMN = Y(L,INDEX)
      IF(Y(L,INDEX).GT.YMX) YMX = Y(L,INDEX)
   30 CØNTINUE
      CALL SCRND (YMX,YMN,YMAX,YMIN)
      IF (KGM.EQ.3.ØR.KGM.EQ.4) GØ TØ 1234                              3400350
      XTITLE(5) = A
      GØ TØ 1235                                                        3400370
```

```
1234 XTITLE(5) = B
1235 CØNTINUE                                                          3400390
     DØ 45 M=1,4
  45 YTITLE(M)=YTIT(M,K)
     CALL QUIK3L (-1,XMIN,XMAX,YMIN,YMAX,1H*,XTITLE,YTITLE,-JCYC,X,
    1             Y(1,INDEX))
     ENCØDE (801,ALPHA) JAM,JNSC
 801 FØRMAT(2I6)
     TITLE(3) = ALPHA(1)
     TITLE(7) = ALPHA(2)
     IF (NHAR.EQ.1) GØ TØ 300
     DØ 40 I=1,4
  40 TITLE(I+8) = THETA(I)
     ENCØDE (116,ALPHA) THEANG(J)
 116 FØRMAT(F12.4)
     TITLE(10) = ALPHA(1)
     TITLE(11) = ALPHA(2)
     GØ TØ 350
 300 DØ 41 I=1,4
  41 TITLE(I+8) = ALØAD(I)
     ENCØDE (802,ALPHA) J
 802 FØRMAT(I6)
     TITLE(11) = ALPHA(1)
 350 CØNTINUE
     CALL RITE2V (46,1005,1023,90,1,72,1,TITLE,IERR)
     IF (IERR.NE.0) WRITE(6,800) IERR
 800 FØRMAT(- IERR =-,I3,- CHARACTER CØUNT WHERE WRITING WAS STØPPED-)
 101 CØNTINUE                                                          3400580
 100 CØNTINUE                                                          3400590
     RETURN                                                            3400600
     END                                                               3400610
```

SUBROUTINE ETRAP

This is an error trap subroutine which can be called by the MAIN routine at various stages of program execution. If the indicator NIX is not equal to zero, MAIN will call ETRAP and indicate the proper error message to be printed.

```
FØR,IS ETRAP,ETRAP
      SUBRØUTINE ETRAP                                                  2300030
      INTEGER SAVJTC,SAVSTP,Q,THICK
      CØMMØN STØRY(16),TALE(16),XMAT(110,10),STD(10),SADUS(30),RADUS(30) 2300050
      CØMMØN TADUS(30),UADUS(30),SAVTIC(900)                            2300060
      CØMMØN XN,TEFREE,TIC,PHI,STØP,RESTØP,RTICK,G1,XNL                 2300070
      CØMMØN NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)  2300080
      CØMMØN JRSTØP(30),NREG,NSEGTL,NMPT,MATPRP,NCUPLE,NRGEND,NSYM,NRG  2300090
      CØMMØN NRC,NSC,NIX,IERRØR,IØUT,MAT,KGEØM,IGEØM,ITYPE,ISTTAB,KELVIN 2300100
      CØMMØN IBEGIN,NPRØB,NHARM,NSEG,NERRØR, Q ,NSMAX,THICK             2300110
      DIMENSIØN NØGØØD(790)                                             2300120
      DIMENSIØN      A1(20)    ,A2(23)    ,A3(22)    ,A4(24)    ,A5(29)    2300130
      DIMENSIØN      A6(24)    ,A7(20)    ,A8(17)    ,A9(16)    ,A10(17)   2300140
      DIMENSIØN      A11(29)   ,A12 (25)  ,A13(15)   ,A14(15)   ,A15(29)   2300150
      DIMENSIØN      A16(30)   ,A17 (9)   ,A18(9)    ,A19(9)    ,A20(9)    2300160
      DIMENSIØN      A21(9)    ,A22 (9)   ,A23(9)    ,A24(9)    ,A25(9)    2300170
      DIMENSIØN      A26(9)    ,A27 (20)  ,A28(13)   ,A29(15)   ,A30(22)   2300180
      DIMENSIØN      A31(21)   ,A32 (27)  ,A33(29)   ,A34(29)   ,A35(13)   2300190
      DIMENSIØN A36(19)                                                 2300200
      DIMENSIØN      A37(15)   ,A38(15)   ,A39(15)   ,A40(15)              2300210
      DIMENSIØN A41(24 ), A42(22)                                       2300220
      EQUIVALENCE (NØGØØD(1),A1(1)),(NØGØØD(21),A2(1))                  2300230
      EQUIVALENCE (NØGØØD(44),A3(1)),(NØGØØD(66),A4(1))                 2300240
      EQUIVALENCE (NØGØØD(90),A5(1)),(NØGØØD(119),A6(1))                2300250
      EQUIVALENCE (NØGØØD(143),A7(1)),(NØGØØD(163),A8(1))               2300260
      EQUIVALENCE (NØGØØD(180),A9(1)),(NØGØØD(196),A10(1))              2300270
      EQUIVALENCE (NØGØØD(213),A11(1)),(NØGØØD(242),A12(1))             2300280
      EQUIVALENCE (NØGØØD(267),A13(1)),(NØGØØD(282),A14(1))             2300290
      EQUIVALENCE (NØGØØD(297),A15(1)),(NØGØØD(326),A16(1))             2300300
      EQUIVALENCE (NØGØØD(356),A17(1)),(NØGØØD(365),A18(1))             2300310
       EQUIVALENCE (NØGØØD(374),A19(1)),(NØGØØD(383),A20(1))            2300320
      EQUIVALENCE (NØGØØD(392),A21(1)),(NØGØØD(401),A22(1))             2300330
      EQUIVALENCE (NØGØØD(410),A23(1)),(NØGØØD(419),A24(1))             2300340
      EQUIVALENCE (NØGØØD(428),A25(1)),(NØGØØD(437),A26(1))             2300350
      EQUIVALENCE (NØGØØD(446),A27(1)),(NØGØØD(466),A28(1))             2300360
      EQUIVALENCE (NØGØØD(479),A29(1)),(NØGØØD(494),A30(1))             2300370
      EQUIVALENCE (NØGØØD(516),A31(1)),(NØGØØD(537),A32(1))             2300380
      EQUIVALENCE (NØGØØD(564),A33(1)),(NØGØØD(593),A34(1))             2300390
      EQUIVALENCE (NØGØØD(622),A35(1)),(NØGØØD(635),A36(1))             2300400
      EQUIVALENCE (NØGØØD(654),A37(1)),(NØGØØD(669),A38(1))             2300410
      EQUIVALENCE (NØGØØD(684),A39(1)),(NØGØØD(699),A40(1))             2300420
      EQUIVALENCE (NØGØØD(714),A41(1)),(NØGØØD(738),A42(1))             2300430
      INTEGER  A1,A2,A3,A4,A5,A6,A7,A8,A9,A10,A11,A12,A13,A14,A15,A16   2300440
      INTEGER  A17,A18,A19,A20,A21,A22,A23,A24,A25,A26,A27,A28,A29,A30  2300450
      INTEGER  A31,A32,A33,A34,A35                                      2300460
      INTEGER A36                                                       2300470
        INTEGER A37,A38,A39,A40,A41,A42
      WRITE(6,17)                                                       2300490
   17 FØRMAT(1H1)                                                       2300500
        DATA (A1(I),I=1,14)/
     A                          80HØNE ØF THE MATERIAL PRØPERTY TABLES CAN 2300520
     1NØT BE IDENTIFIED AS ISØT, ØRTH, ØR STIF./                        2300530
        DATA (A2(I),I=1,16)/
     A                          92HA MATERIAL PRØPERTY TABLE NAME FØR A SE 2300550
     1GMENT CANNØT BE FØUND IN THE TABLE LIST.          /               2300560
        DATA (A3(I),I=1,15)/
     A                          88HTHE TYPE ØF GEØMETRY ØF A SEGMENT CANNØ 2300580
     1T BE IDENTIFIED AS ØNE HANDLED BY THE PRØGRAM.   /                2300590
        DATA (A4(I),I=1,16)/
     A                          96HTHE TYPE ØF MATERIAL PRØPERTY TABLE FØR 2300610
     1 A SEGMENT CANNØT BE IDENTIFIED AS ISØT, ØRTH, ØR STIF.  /        2300620
```

```
   DATA (A5(I),I=1,20)/
A                        116HTHE WALL CØNSTRUCTIØN ØF A SEGMENT CANN 2300640
1ØT BE IDENTIFIED AS SING, EQUA, UNEQ, ØR BLAN.                      2300650
2        /                                                            2300660
   DATA (A6(I),I=1,16)/
A                         96HTHE TYPE ØF TEMPERATURE INPUT FØR A SEG 2300680
1MENT CANNØT BE IDENTIFIED AS THST, NØTH, THCN, ØR THIN.  /          2300690
   DATA (A7(I),I=1,14)/
A                         80HTHE PRØGRAM CANNØT DETERMINE WHETHER TH 2300710
1E PRØBLEM INPUT IS LINEAR ØR NØN-LINEAR. /                          2300720
   DATA (A8(I),I=1,12)/
A                         68HTHE PRØGRAM CAN EXECUTE ØNLY ØNE NØN-LI 2300740
1NEAR PRØBLEM PER DATA DECK.  /                                      2300750
   DATA (A9(I),I=1,11)/
A                         64HTHE LØAD INDICATØR CLUES CAN ØNLY BE ZE 2300770
1RØ, BLANK, ØNE, ØR FØUR. /                                          2300780
   DATA (A10(I),I=1,12)/
A                         68HTHE PRØGRAM CAN EXECUTE ØNLY ØNE THERMA 2300800
1L LØAD PRØBLEM PER DATA DECK./                                      2300810
   DATA (A11(I),I=1,20)/
A                        116HTHE MAGIC CYCLE HAS GØNE PAST STØP BY M 2300830
1ØRE THAN THE PERMITTED VALUE. CHECK TØ  SEE IF FIXED STEP SIZE IS   2300840
2TØØ LARGE. /                                                        2300850
   DATA (A12(I),I=1,17)/
A                        100HTHE RIEMAN VARIABLE, IEND, WHICH SIGNAL 2300870
1S THE END ØF A SEGMENT SHØULD ØNLY BE ZERØ ØR NEGATIVE ØNE.  /      2300880
   DATA (A13(I),I=1,10)/
A                         60HFIRST PHI ØR S TABLE VALUE DØES NØT MAT 2300900
1CH MAGIC CARD VALUE. /                                              2300910
   DATA (A14(I),I=1,10)/
A                         60HFINAL PHI ØR S TABLE VALUE DØES NØT MAT 2300930
1CH MAGIC CARD VALUE. /                                              2300940
   DATA (A15(I),I=1,20)/
A                         116HTHE INTERPØLATED VALUE ØF TEMPERATURE  2300960
1FØR THE MATERIAL PRØPERTY TABLE IS LESS THAN THE SECØND TEMPERATUR 2300970
2E VALUE.    /                                                       2300980
   DATA (A16(I),I=1,20)/
A                         120HTHE INTERPØLATED VALUE ØF TEMPERATURE  2301000
1FØR THE MATERIAL PRØPERTY TABLE IS GREATER THAN THE LAST VALUE ØF  2301010
2TEMPERATURE.    /                                                   2301020
   DATA (A17(I),I=1,6)/
A                         36HTHE K11 STIFFNESS PARAMETER IS ZERØ./   2301040
   DATA (A18(I),I=1,6)/
A                         36HTHE K12 STIFFNESS PARAMETER IS ZERØ./   2301060
   DATA (A19(I),I=1,6)/
A                         36HTHE K21 STIFFNESS PARAMETER IS ZERØ./   2301080
   DATA (A20(I),I=1,6)/
A                         36HTHE K22 STIFFNESS PARAMETER IS ZERØ./   2301100
   DATA (A21(I),I=1,6)/
A                         36HTHE K33 STIFFNESS PARAMETER IS ZERØ./   2301120
   DATA (A22(I),I=1,6)/
A                         36HTHE D11 STIFFNESS PARAMETER IS ZERØ./   2301140
   DATA (A23(I),I=1,6)/
A                         36HTHE D12 STIFFNESS PARAMETER IS ZERØ./   2301160
   DATA (A24(I),I=1,6)/
A                         36HTHE D21 STIFFNESS PARAMETER IS ZERØ./   2301180
   DATA (A25(I),I=1,6)/
A                         36HTHE D22 STIFFNESS PARAMETER IS ZERØ./   2301200
   DATA (A26(I),I=1,6)/
A                         36HTHE D33 STIFFNESS PARAMETER IS ZERØ./   2301220
   DATA (A27(I),I=1,14)/
```

```
     A                              80HTHE PRØGRAM CANNØT DETERMINE WHETHER TH 2301240
     1E PRØBLEM INPUT IS THIC, RWAF, ØR ST10.  /                              2301250
        DATA (A28(I),I=1,9)/
     A                              52HTHE ØUTPUT FLAG FØR THE STRESSES, IØUT, 2301270
     1IS NØT ZERØ. /                                                          2301280
        DATA (A29(I),I=1,10)/
     A                              60HTHE Y2 BLØCK IN THE SEGMENT MAGIC ØUTPU 2301300
     1T IS SINGULAR.        /                                                 2301310
        DATA (A30(I),I=1,15)/
     A                              88HIN THE CØMPUTATIØN ØF THE REGIØN STIFFN 2301330
     1ESSES, THE K22 MATRIX WAS NØT PØSITIVE DEFINITE. /                      2301340
        DATA (A31(I),I=1,14)/
     A                              84HIN THE CØMPUTATIØN ØF THE REGIØN LØADS, 2301360
     1 THE K22 MATRIX WAS NØT PØSITIVE DEFINITE.   /                          2301370
        DATA (A32(I),I=1,18)/
     A                            108HIN THE CØMPUTATIØN ØF THE REDUCED FLEXI 2301390
     1BILITY MATRIX, THE REDUCED STIFFNESS MATRIX IS SINGULAR                 2301400
     2   /                                                                    2301410
        DATA (A33(I),I=1,20)/
     A                            116HFØR KINEMATIC LINKS BETWEEN SEGMENTS, T 2301430
     1HE DEPENDENT JØINT NUMBER MUST BE GREATER THAN THE INDEPENDENT JØI      2301440
     2NT NUMBER. /                                                            2301450
        DATA (A34(I),I=1,20)/
     A                            116HTHE NUMBER ØF PØINTS IN THE ST TABLE MU 2301470
     1ST BE BETWEEN 2 AND 30.                                                 2301480
     2              /                                                         2301490
        DATA (A35(I),I=1,9)/
     A                              52HFØR NØN-LINEAR ANALYSIS, THE HARMØNIC M 2301510
     1UST BE ZERØ. /                                                          2301520
        DATA (A36(I),I=1,13)/
     A                              76HA STRESS PRØPERTY CLUE CANNØT BE IDENTI
     AFIED AS RING, STRI, SHEL, ØR WAFF.    /
        DATA (A37(I),I=1,10)/
     A                              60HTHE STRESS CLUE FØR PHI INNER IS NØT ST
     ARI, SHEL, ØR WAFF.   /
        DATA (A38(I),I=1,10)/
     A                              60HTHE STRESS CLUE FØR PHI ØUTER IS NØT ST
     ARI, SHEL, ØR WAFF.   /
        DATA (A39(I),I=1,10)/
     A                              60HTHE STRESS CLUE FØR THETA INNER IS NØT
     ARING, SHEL, ØR WAFF. /
        DATA (A40(I),I=1,10)/
     A                              60HTHE STRESS CLUE FØR THETA ØUTER IS NØT
     ARING, SHEL, ØR WAFF. /
        DATA (A41(I),I=1,16)/
     A                              96HTEMPERATURE VALUES (CØLUMNS 2-END) IN T
     AHE MATERIAL PRØPERTY TABLE MUST BE IN INCREASING ØRDER.  /
        DATA (A42(I),I=1,15)/
     A                              88HJ-TH JØINTS ØN SUCCESSIVE INTER-REGIØN
     AKINEMATIC LINK CARDS MUST BE IN INCREASING ØRDER./
      GØ TØ (8000,8036,8086,8087,8089,8090,8013,8009,8031,8008,8001,8002 2301670
     1,8003,8006,8007,8067,8101,8102,8103,8104,8105,8106,8107,8108,8109, 2301680
     28110,8088,110,8120,8841,8842,8777,8797,8787,8501,8111,11,21,32,42  2301690
     3,8114,8118,8502,8503),NERRØR                                       2301700
8000  II=1                                                               2301710
      III=20                                                             2301720
      GØ TØ 505                                                          2301730
8036  II=21                                                              2301740
      III=43                                                             2301750
      GØ TØ 505                                                          2301760
8086  II=44                                                              2301770
```

```
      III=65
      GØ TØ 505
 8087 II=66
      III=89
      GØ TØ 505
 8089 II=90
      III=118
      GØ TØ 505
 8090 II=119
      III=142
      GØ TØ 505
 8013 II=143
      III=162
      GØ TØ 505
 8009 II=163
      III=179
      GØ TØ 505
 8031 II=180
      III=195
      GØ TØ 505
 8008 II=196
      III=212
      GØ TØ 505
 8001 II=213
      III=241
      GØ TØ 505
 8002 II=242
      III=266
      GØ TØ 505
 8003 II=267
      III=281
      GØ TØ 505
 8006 II=282
      III=296
      GØ TØ 505
 8007 II=297
      III=325
      GØ TØ 505
 8067 II=326
      III=355
      GØ TØ 505
 8101 II=356
      III=364
      GØ TØ 505
 8102 II=365
      III=373
      GØ TØ 505
 8103 II=374
      III=382
      GØ TØ 505
 8104 II=383
      III=391
      GØ TØ 505
 8105 II=392
      III=400
      GØ TØ 505
 8106 II=401
      III=409
      GØ TØ 505
 8107 II=410
      III=418
```

```
      GØ TØ 505
 8108 II=419
      III=427
      GØ TØ 505
 8109 II=428
      III=436
      GØ TØ 505
 8110 II=437
      III=445
      GØ TØ 505
 8088 II=446
      III=465
      GØ TØ 505
  110 II=466
      III=478
      GØ TØ 505
 8120 II=479
      III=493
      GØ TØ 505
 8841 II=494
      III=515
      GØ TØ 505
 8842 II=516
      III=536
      GØ TØ 505
 8777 II=537
      III=563
      GØ TØ 505
 8797 II=564
      III=592
      GØ TØ 505
 8787 II=593
      III=621
      GØ TØ 505
 8501 II=622
      III=634
      GØ TØ 505
 8111 II=635
      III=653
      GØ TØ 505
   11 II =654
      III=668
      GØ TØ 505
   21 II =669
      III=683
      GØ TØ 505
   32 II =684
      III=698
      GØ TØ 505
   42 II =699
      III=713
      GØ TØ 505
 8114 II=714
      III=737
      GØ TØ 505
 8118 II= 738
      III=759
      GØ TØ 505
 8502 WRITE(6,852)
  852 FØRMAT(////59X,14H IERRØR = 8502///4X,-SEGMENT PHI DIMENSIØN (TIC)
     1 IS ØUTSIDE THE Z VERSUS RØ INPUT TABLE.-)
```

```
      GØ TØ 512
 8503 WRITE(6,853)
  853 FØRMAT(////59X,14H IERRØR = 8503///4X,-SEGMENT PHI DIMENSIØN (STØP
     1) IS ØUTSIDE THE Z VERSUS RØ INPUT TABLE.-)
      GØ TØ 512
  505 WRITE(6,510)IERRØR,(NØGØØD(I),I=II,III)
  510 FØRMAT(////59X,10H IERRØR = ,I4///4X,32A4//20X,28A4)
  512 RETURN
       END
```

REFERENCES

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